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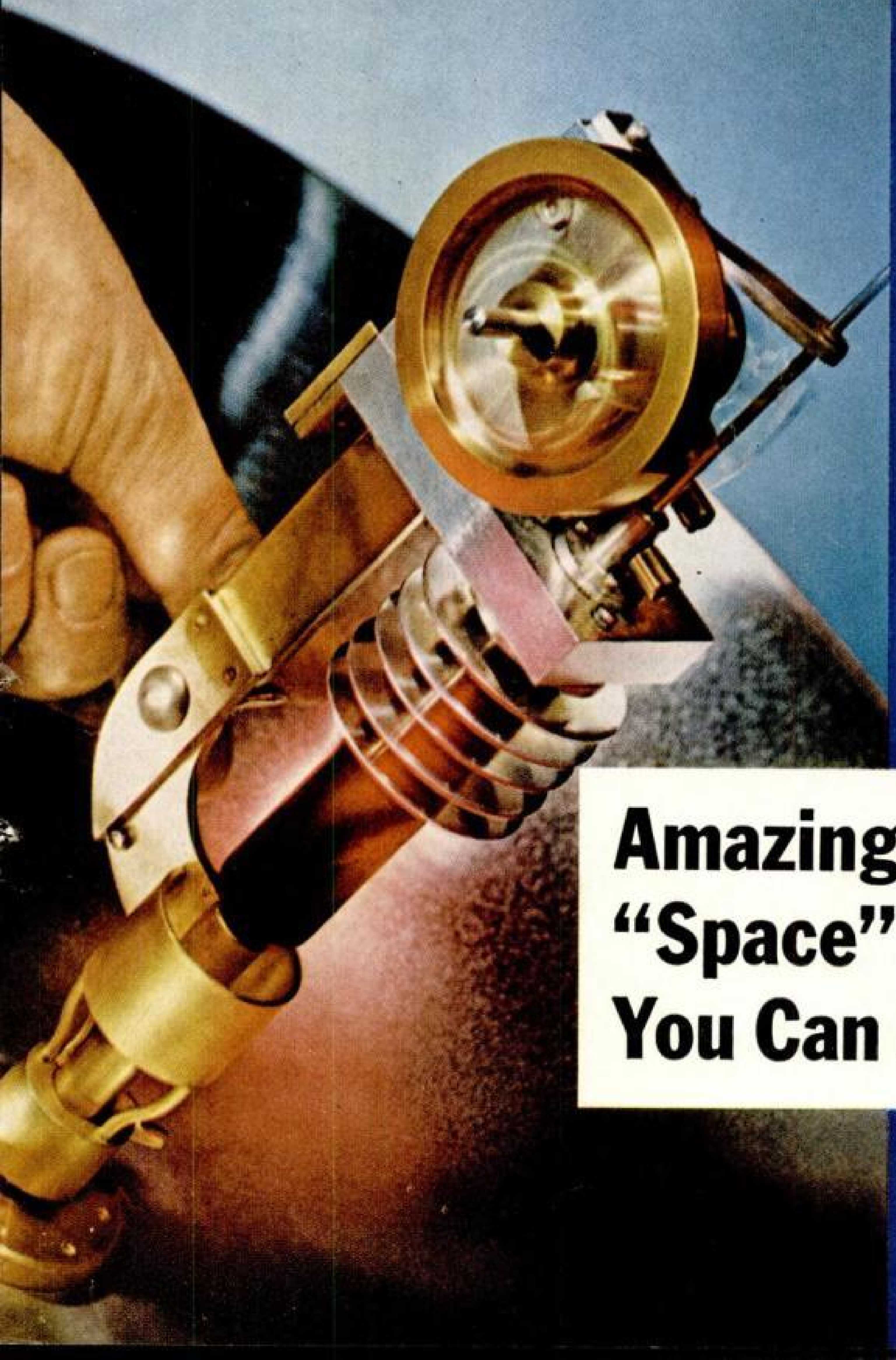
Popular Science

Monthly



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July 1965

PS Exclusive! Art Arfons, the fastest man on wheels, tells how he plans to drive faster than the speed of sound—about 720 miles per hour. Page 46.

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Coming for '66: new engines, bigger compacts, front drive (above), and lots of surprises. Page 35.

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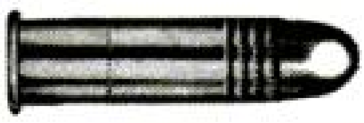

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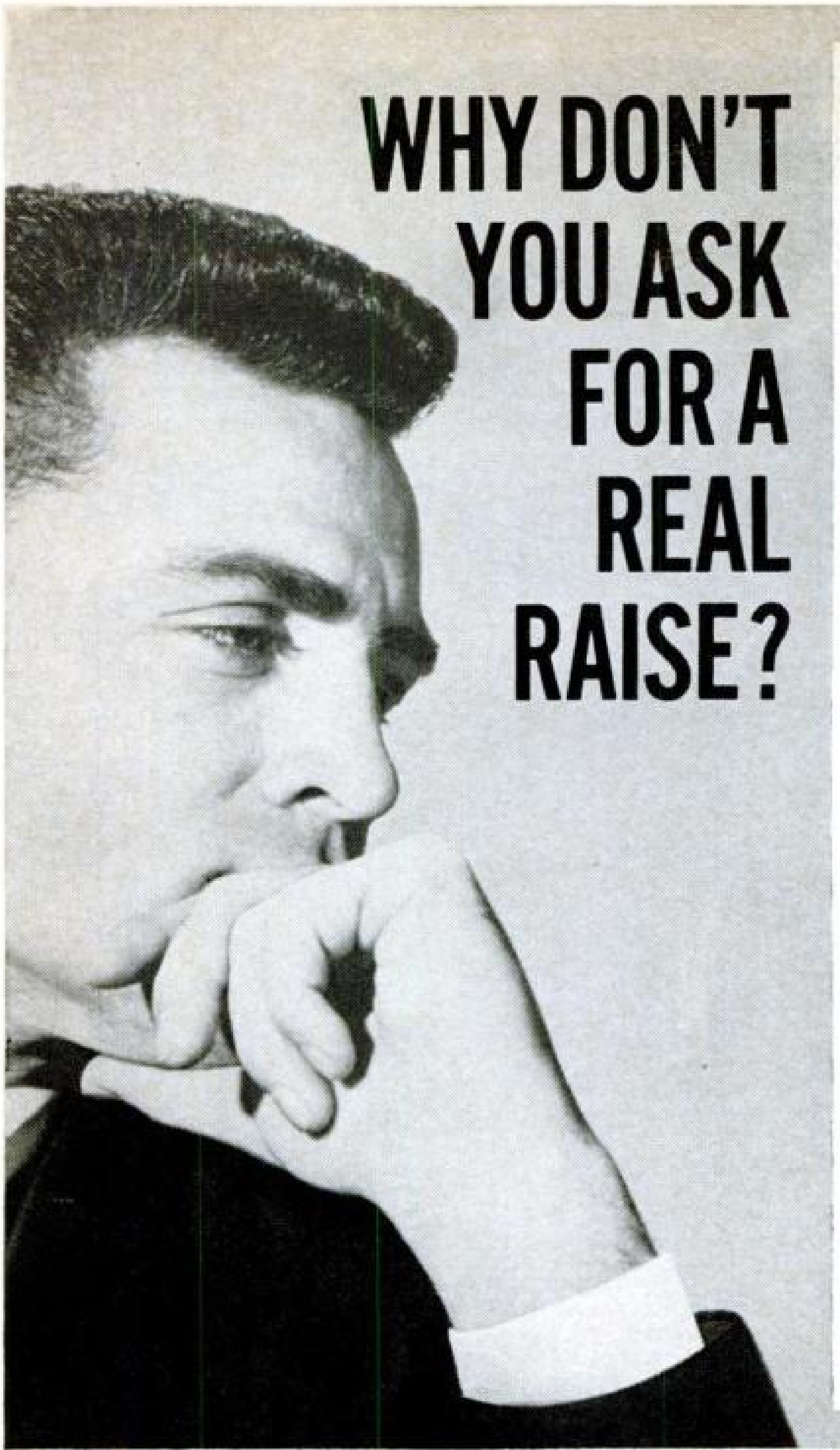

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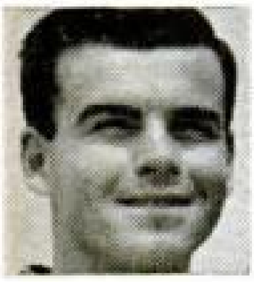

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- ☐ Other (please specify) ____________

Name ____________ (Please indicate whether Mr., Miss or Mrs.) Age ________

Address ____________

City ____________ State ____________ Zip Code ____________

Employed by ____________ Working Hours ____ A.M. to ____ P.M.

Occupation ____________

Special low rates to members of the U. S. Armed Forces! Special training programs for industry.

Urheberrechtlich geschütztes Material

PS readers talk back

Want to get something off your chest? Write "Readers Talk Back," Popular Science, 355 Lexington Ave., New York, N.Y. 10017.

Stupid Advertising Signs?

"Stupid Highway Signs Can Kill" [May], but there are other road hazards equally at fault. How about a campaign to get rid of neon signs using near-red or green light? These are particularly bad on heavily traveled streets or roads where stop-and-go lights are also found. A second hazard is the highway billboard that obscures signs and distracts a driver's attention. Perhaps the billboard is on the way out with the present campaign for beautifying America, including its roads.

L. M. WESTERLY, Orange, N.J.

. . . Occasionally I travel Mass. Route 128 to reach the Mass. Pike. Only once have I managed to get on the Pike ramp without overshooting. Twice I nearly caused an accident trying. Never have I traveled 128 without seeing at least one accident, and on my last trip, we counted 15. The main causes: Signs too small, too close to the exits, and not clear at the speeds traveled; no breaker strip between opposing lanes; no lighting, and black top that blends with the edges of the driving lanes at night. Route 128 is difficult to travel even in daylight.

T/SGT ALTON W. GREULING, Dover, N.H.

Consider the Whale—

To protect yourself in a collision, or in strong acceleration, think of this:

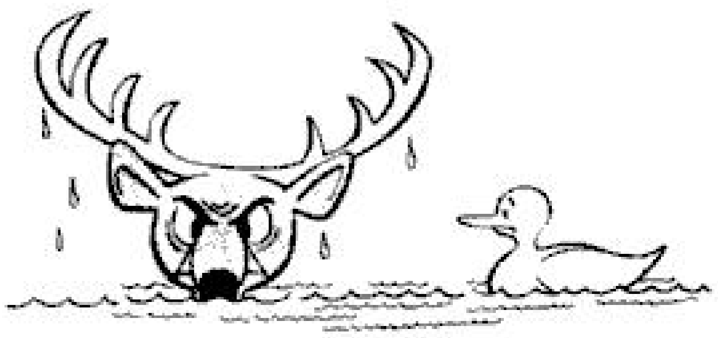
A whale washed out on shore is crushed by its own weight, but can live safely in water—because in water the weight of the body is distributed throughout the volume instead of accumulating on one side. For the same reason, a man suspended in liquid in a container can

withstand collision and acceleration better. He can be touching the bottom or the sides of the container and get the same protection. Impact is felt as a slight increase in pressure. But keep the ears and mouth connected to outside air with a snorkel!

MAGOROH MARUYAMA, Berkeley, Calif.

Beavers vs. Atomic Accidents?

One of your readers [Apr.], writing about the "greatest dam thing ever," says: "Rampart Canyon Dam, built by the Army Corps of Engineers, will outproduce any Soviet dam . . . proof . . . that the world's leading dam builders are American." Is he as proud of the half-bil-



lion dollars and the unreplaceable wild life these West Point intellectuals want to drown?

The proposed dam is to produce five million kilowatts. In the same issue of PS, General Electric is said to offer million-kilowatt atomic reactors for $103 million each. Five reactors (equivalent in kilowatts to the dam) would cost less than half that estimated for the dam.

HERBERT C. SABOL, S. Lancaster, Mass.

From the Horse's Mouth

Regarding Smokey Yunick's reply to an owner of a 1964 Mercury Montclair [Mar.]: Installation of grease fittings and ordinary chassis lubes can do more harm to the suspension system than 100,000 miles of severe driving. Manufacturers' warranties are based on the 36,000-mile interval between regreasing. Under these conditions it would be desirable to adhere to factory-recommended practices.

TOM WESTERLIN
Ford Motor Co., Dearborn.

Believe It or Not . . .

I saw two ways to solder aluminum in March ["The Fourth Rule for Soldering"]. There is another way to do it. Clean well, apply flux, heat until flux smokes, then use ordinary solder. Believe it or not, I saw it in an old 1936 magazine.

BURDETTE BOLENBAUGH, Ohio City, Ohio.

Eliminating the Oil Change

"50,000 Miles Without an Oil Change" [Mar.] was particularly interesting. It is refreshing to see an automotive test program so well described.

Our company makes a turbine-driven centrifugal automotive oil filter which is devoid of the mechanical complexities of the Bergstrom unit. The turbine-driven centrifuge has been well proven through 10 years of use on engines in a variety of vehicles. Thorough filtration is attained with a powerful centrifugal field gen-

CONTINUED

Urheberrecht ch geschütztes Material

Is July the right month to buy an outboard?

Lots of boaters say so! With all of summer ahead—vacations coming up—long, lazy days in the sun, swimming, skiing and fishing. Then the long, beautiful Indian summer—c'mon in, the water's fine! Especially at your Mercury dealer's. Right now he's featuring three power-packed, economical ways to get into family outboarding: the Merc 650, 500 and 350!

The Merc 650: 65 HP. Great ski motor! This 4-cylinder, small-bore, short-stroke outboard outpulls, outruns, outlasts competitive "big-barrel" V-4s—on less gas! And it's *quiet!*

The Merc 500: 50 HP. Economical—versatile. Exclusive 1965 Mercury features—from its sound-isolated cowl to Jet-Prop exhaust—make the Merc 500 the most advanced outboard in its class! And it's *quiet!*

The Merc 350: 35 HP. Looks husky, is husky—yet it's the *lightest* 35 HP outboard ever built! Flo-Torque rubber safety clutch makes Mercury the only outboard which has no shear pin (or drive pin) to fail. It's quiet, too.

You get more RUN for your money with Mercury 1965 . . . 100, 90, 65, 50, 35, 20, 9.8, 6 and 3.9 hp.

KIEKHAEFER MERCURY

MERCURY

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Urheberrechtlich geschütztes Material

"Find-It-Yourself" Kit

Looking for bathroom fixtures, blow torches, a block & tackle, building materials... anything? Just let your fingers do the walking. Action-People do.

PS readers talk back continued

erated without belt drives and their mounting problems. Results substantiate the findings of your centrifugal test report. The centrifugal filtration process is enjoying ever-widening areas of application. Your coverage of the subject is most opportune.

Ellis M. Wellman, Dev. Eng.
The Weatherhead Co., Cleveland.

. . . I was surprised to see your headlines and writeup for a product only partially successful during a controlled test.

In 1962 I installed a Frantz Oil Cleaner on my '57 Ford. After a year without an oil change, my oil was free of contamination (carbon, water, and acid), and there was not a trace of sludge when the rocker-arm covers were removed. I was so enthusiastic, I became a distributor.

There are about a million vehicles equipped with Frantz Oil Cleaners and their owners will testify that this product lives up to the manufacturer's claims.

Arthur O. Hawkins, Sunnyvale, Calif.

One Use for Old Pants

I built your shop vacuum cleaner [Jan.] and I am really satisfied with the results. Instead of buying a dust filter bag, I used a leg from

a pair of cotton pants. I cut the leg at the pocket and folded it for double thickness, then sewed up the bottom and installed it on my cleaner. It would not be a bad idea to use a three-wire plug and cord—everything else is usually grounded in the shop.

Thomas H. Donohue, Roswell, N.M.

Uncaring Snoopees

Electronic snooping has reached a highly sophisticated level when a truck, loaded with electronic equipment, can tell which TV program one is watching [May, p. 128]. Most upsetting was that no one was reported to have resisted this open invasion of privacy. Project such detection devices into the future, under some authoritarian state, and visualize the tremendous monitoring influence such equipment would have on thought control. Where can a man go to escape detection of having watched some unauthorized program? As the world grows smaller, do not the rights of man loom larger still?

Dr. Howard E. Katz, Rego Park, N.Y.

Urheberrechtlich geschütztes Material

FREE! 10 Tested, Proven Mail Order Money-makers which can put you in the RICH, FABULOUS MAIL ORDER BUSINESS OVERNIGHT—on a "shoe string"!

Mail Order Intelligence Reveals Inside Secrets to Making Money by Mail! *No catalogs or mail schemes!*

Yes, it's true! We'll prove to you at our expense that the Mail Order Intelligence can help you enjoy the mail order riches thousands of others are getting—without obligation or risk on your part. He'll reveal to you 10 PROVEN MAIL ORDER MONEY-MAKERS that are putting thousands of dollars in orders every week into the pockets of his clients. And he'll show you how you can cash in—big, too!

You'll read how you can place a $25 ad in a national publication read by hundreds of thousands of people. It takes only a few orders to pay for the ad cost—*after that, it's ALL PROFIT!* You'll learn how to get into the richly rewarding mail order business on a "shoe string"! No drop-ship catalogs to buy—no inventory to stock, no letters to mail—no needless expenses. Yes, he'll prove to you, at his expense, that running inexpensive mail order ads in newspapers, magazines, etc., is the only way to start building your mail order fortune!

Small Ad Makes $1,200 Profit!

The uncanny advertising genius of the Mail Order Intelligence comes up with mail order winners time after time. He creates new products and ideas. Writes power-selling copy, prepares the ads, and places them at his expense before advising his clients. Then, when the results are in, he turns them over to you. A typical example is the ad on Hypnotism which he recently sold for $15,000.00, along with another promotion. The first time this ad ran, it returned a profit of $1,200.00! That's the kind of money you can make on mail order advertising when you know how!

His Services Cost You Nothing

Right this minute the Mail Order Intelligence has 10 newly proven and tested money-makers that his agency clients are using. They are people just like you. Folks who are putting their spare time to profitable use. People who are building a rich and rewarding future for themselves and their family without hard work and a big investment in time and money. Mail order is the easiest and most enjoyable business of all!

Best of all, as his client—*you pay nothing for his services!* As a recognized advertising agency he receives a commission from the publications which run his ads. Most folks don't know this, but this is the rule, and you can check this fact with your local newspaper. This means you enjoy the services of one of the country's greatest mail order geniuses without cost!

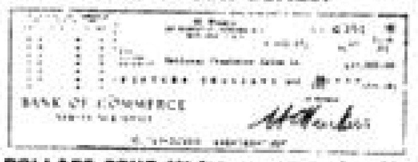
Here's How You Make Money

Every time the Mail Order Intelligence tests new and successful ads, he notifies his clients. You receive a full report on the results . . . recommended publications . . . profit per order . . . source of supply . . . plus printed copies of the advertisement—everything you need. If you want to cash in on the new offer, you simply notify Mail Order Intelligence. He selects and reserves ads to meet your budget. All the orders and money go to you. No one else is permitted to run this ad in the same publication—your schedule is protected. Nothing could be simpler, more profitable or easier! And what does this cost you? *Nothing!* His services are yours FREE since magazines pay Mail Order Intelligence the standard agency commission. Little wonder folks from all over the country are using his services!

Pyramid Profits into Fortune

Most fortunes, as you know, are made by pyramiding profits. Many successful mail order operators started with one small ad. They took the profit from that ad and built it into two! The profits from two bought four—until profits were pouring in from more and more publications! Imagine! As little as $40 profit a week from each ad in 5 magazines means OVER $200 EXTRA WEEKLY INCOME! Plus each new customer name leads to more sales during the year. No wonder so many who started on a "shoe string" have been able to pyramid their profits into $40,000.00 or more yearly!

MAIL ORDER INTELLIGENCE WAS PAID $15,000 FOR 2 FANTASTIC MAIL ORDER DEALS!



DOLLARS POUR IN for everyone when the Intelligence creates and adds his magic touch to mail order promotions! He was recently paid $15,000 for two promotions that he sold to a leading mail order operator. Yet his clients were able to use promotions like this without paying one penny for the "rights!" You can do the same!

Success the Proven Way

This plan is so sound that it has succeeded time and again where drop-ship catalogs and other methods have failed. Those who use it have prospered. What is the secret? Simply this: by running small ads on proven winners in newspapers and magazines, you reach thousands of mail order buyers per dollar! To mail a catalog or sales letter costs over $30.00 per thousand without even paying for printing costs. So you can see that right from the start the cards are stacked against you in other methods. The Mail Order Intelligence's proven technique keeps your costs down, your profits up . . . is the fastest and easiest road to mail order riches. And his results prove it!

$130,000 MAIL ORDER SUCCESS was split by clients of the MAIL ORDER INTELLIGENCE in just one promotion. He prefers to remain anonymous because of the many agency clients he services. You can receive 10 of his money-making, proven mail order successes—FREE!

Free! Over $50,000 in Money-Making Reports!

What the Mail Order Intelligence has done for others, he can do for you. He has prepared a fully documented portfolio of case histories that can lead you to a golden future the easy, proven way. You'll receive his current 10 hottest money-making mail order promotions—inside facts on how to start in mail order on a "shoe string" plus 2 Special Reports that cost big business over $50,000! Steel tycoon Charles Schwab paid $25,000 for one of these reports and it's sent to you in its entirety—not a word cut. The other Report reveals little-known advertising secrets and was prepared for American Publishers at a fee of $25,000! Both are invaluable to you, whether you use the knowledge for mail order or any other endeavor. Both are yours FREE—for returning the Coupon below.

$15,000 PAID for rights to these Mail Order Intelligence ads!

FREE!

$50,000 Paid

for these two reports that you can receive FREE without obligation! To those who are sincerely interested in mail order riches and financial security, we will send 2 amazing Reports that can change your life—absolutely FREE! So priceless, so valuable are these Reports that each was created at a fee of $25,000! This is a documented and verified fact. They are offered to those who act now. The supply is definitely limited.

Turn Your Spare Time Into Your Gold Mine!

Nothing beats mail order for excitement, riches, pleasures, easy-going working hours and security. The world is your marketplace. No doors to pound . . . no wearing out of shoe leather . . . no taking "guff" from customers. No big investment to get started. The mailman does the work and brings the orders full of cash to your home. Whether young or old, skilled or unskilled, educated or uneducated, the coupon below can start you on the road to a bright and profitable mail order future. To start the dollars coming into your mailbox—mail the coupon now. You have nothing to lose—a happy and prosperous exciting life to gain! The supply of Mail Order Portfolios is definitely limited—so send coupon NOW to get everything FREE.

RICHES CAN BE YOURS!

Mail order pays off handsomely for thousands, and can enrich you, too. This is the magnificent home of the Mail Order Intelligence, in a luxurious and exclusive suburb where homes sell for $75,000 and more. Many little known operators earn $30,000 to $40,000 yearly. How about you? And is that a ROLLS ROYCE in the driveway?

FREE! MONEY-MAKING MAIL ORDER KIT!

MAIL ORDER INTELLIGENCE, Inc., Dept. 28, 507 Fifth Ave., New York 17, N.Y.

YES, I want to make money in the fabulous mail order business and can invest $25 to $100 in mail order ads IF I approve one of the 10 tested money-makers and decide to be one of your clients; Please send me all the information mentioned in this ad ABSOLUTELY FREE and without obligation on my part. It remains mine to keep. I am over 21 years of age.

NAME ....

ADDRESS ....

CITY ............................ZONE......STATE..............

MAIL ORDER INTELLIGENCE

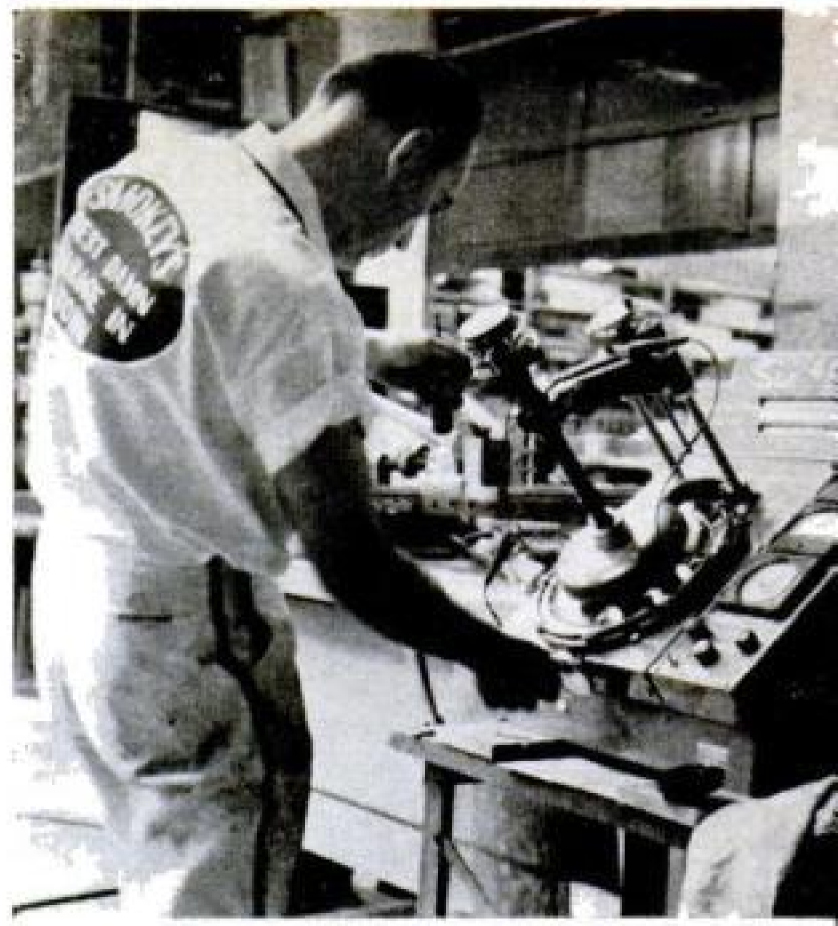
INC.

Dept. 28, 507 Fifth Ave., New York 17, N.Y.

Urheberrechtlich geschütztes Material

'Say, Smokey-'

A clinic on cars by America's most famous mechanic



EACH month in POPULAR SCIENCE, Smokey Yunick will answer questions on cars—family cars, high-performance jobs, hot rods, and racing cars—selected from those sent in by readers. Got a problem? Ask Smokey. You'll find the address at the end of the column. Please *print* your name and address.

► ***"Some users say that the new five-or-more-gap spark plugs are wonderful, never needing regapping and never fouling up. Others say they damage the engine. I got a set for my '60 Ford 6, but won't install them without your opinion. Please?"—C. Boder, Bayville, N.Y.***

The old-timers did a pretty good job in inventing the original spark plugs, and there hasn't been much improvement since. Go ahead and try those five-gappers, so long as you have them. I don't think they'll hurt your engine.

► ***"I put 7.10-by-15 tires on my '62 Rambler in place of the original 6.50-by-15s. The power seems to be cut. How much would the larger tires cut power and why?" —Floyd Sank Jr., Butler, Pa.***

Your power is cut in direct proportion to the increase in the outside circumference of the new tires over the old. Each turn of the rear axle has to propel your car several inches farther than it had to with the smaller tires—and with no increase in horsepower.

► ***"The rear motor mounts on my '60 GMC pickup were replaced a year ago with an 'improved' set from a dealer. Now they're going to pot. Do you know of some make that will stand up?"—William C. Macdonald, Great Falls, Mont.***

The later-model mounts from GMC were improved. Your trouble probably comes from loose bolts holding them. Try using Loctite on the bolts, after tightening to specified torque, or drill and safety-wire them so they'll hold correct pressure against the mounts.

► ***"Someone goofed in installing the front cork valve cover and intake-manifold gasket on my '60 Ford V-8. Is there a way to compress this gasket and get it in without dismantling the car? Can I reach in and clean out the old gasket pieces?"—E. F. Grams, Cheyenne, Wyo.***

Your best fix is to remove the manifold, clean off the pieces of the old gasket, and put in a new one.

► ***"I am having clutch trouble with a '63 Dodge Dart. When it is cold, and I depress the pedal, it's very noisy. This lasts about 15 minutes, until the car is warm. The dealer put in a new clutch, new plate, and throw-out bearing. That just made it worse. Can you help?"—Marvin J. Moeller, Sturgeon Bay, Wis.***

It sounds as if that throw-out bearing is not lined up properly or not turning freely. Have them check the bearing for alignment on the transmission against the pressure-plate fingers. It might be a misalignment of the clutch fork itself.

► ***"When my '63 Rambler started missing on a trip, I pulled into a garage and was told that the carbon high-tension wire between the coil and distributor had gone out.***

CONTINUED

Urheberrechtlich geschütztes Material

There's more to the new Buick Skylark Gran Sport than meets the right foot.

Some people might think a whacking-big 400-cu. in., 325-hp Wildcat V-8 alone is worth the price of admission to a Skylark Gran Sport. Not us Buick people. We had to go and lock that engine to a heavy-duty suspension, a floor-shift 3-speed that's synchronized in all forward gears, and the kind of steering and handling that'll make you want to leave home at the first hint of an open road. Tell you what. Go visit your Buick dealer and ask for a test drive. And then see if the whole car doesn't match that accelerator pedal.

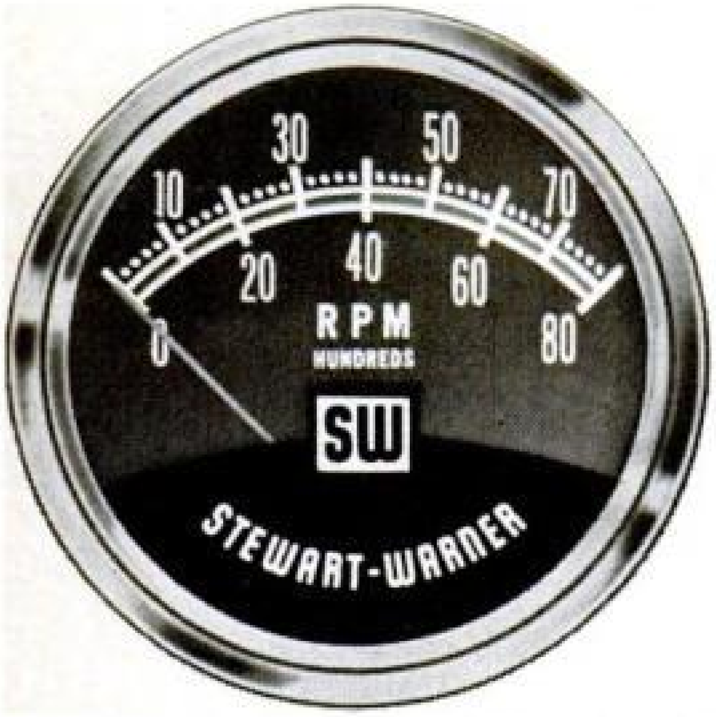
One of the new Gran Sports from Buick.

BUICK MOTOR DIVISION

Urheberrechtlich geschütztes Material

You've cleaned your carburetor, adjusted your spark gap and checked your timing.

Now let's get serious about instrumentation.



Your engine comes out of the shop in top tune—but how can you keep it that way?

Your answer is Stewart-Warner instruments, the fast, accurate way to keep tab on engine efficiency. Stewart-Warner has electric and mechanical tachometers; speedometers; pressure, temperature and vacuum gauges; ammeters; voltmeters. Whatever your instrument need, Stewart-Warner can supply it. And you can choose from handsome S-W face dial designs like the ones below.

See your Stewart-Warner dealer. He's serious about instrumentation. No wonder. He has the most complete line in America.

STEWART-WARNER Symbol of SW Excellence

INSTRUMENT DIVISION

Dept. D-75, 840 Diversey Pkwy., Chicago, Illinois 60614

Smokey Yunick continued

They replaced it with a copper high-tension wire. A few days later at the Rambler garage they saw the copper wire and told me that if I didn't use carbon wire in all parts of the high-tension system it would burn holes in the tops of the pistons. Rambler said the factory so stated. Why?"—H. D. M., DeQueen, Ark.

I doubt that the copper wire would burn holes in the pistons, but if you are concerned about the warranty, put the carbon type back in. For other reasons, you'd better follow Rambler's suggestions—one is electrolysis. Others: radio noise, unbalance of the ignition system.

► *"Even using the best gas, I get an occasional valve noise in my 110-hp. '64 Corvair. It's worse at slow speeds after the engine is warmed up, though sometimes you can hear it at highway speeds. Timing is 'on the mark,' but the noise disappears when the spark is retarded to the point where the engine acts sluggish. Is this a peculiarity of the Corvair, or is there a fix?" —J. L. Schmitt, Chambersburg, Pa.*

This is no more true of the Corvair than of any car that combines low horsepower with tall gears. Quit fooling with the spark advance, and have this car set to factory specs. Then experiment with different makes and grades of fuel until she stops clinking.

► *"I'm not an accelerator stomper, so how come my '61 Chevy 6 with automatic gets only nine miles per gallon? I had a recent tune-up with new points and plugs, had the timing set, and the carb adjusted. It didn't help. Can you?"—Jerry Indich, Brooklyn, N.Y.*

That mileage is way off for this car. Have the cam checked for proper timing, and also get a compression check. If those are up to par, throw your carb away and install a new one. Check the fuel pressure and the carb air cleaner; then put the timing where it belongs and make sure the automatic distributor advance is correct. If your transmission isn't slipping, you should be back in the ball park again.

► *"The oil pressure holds at a satisfactory 60 pounds with a cold engine in my '57*

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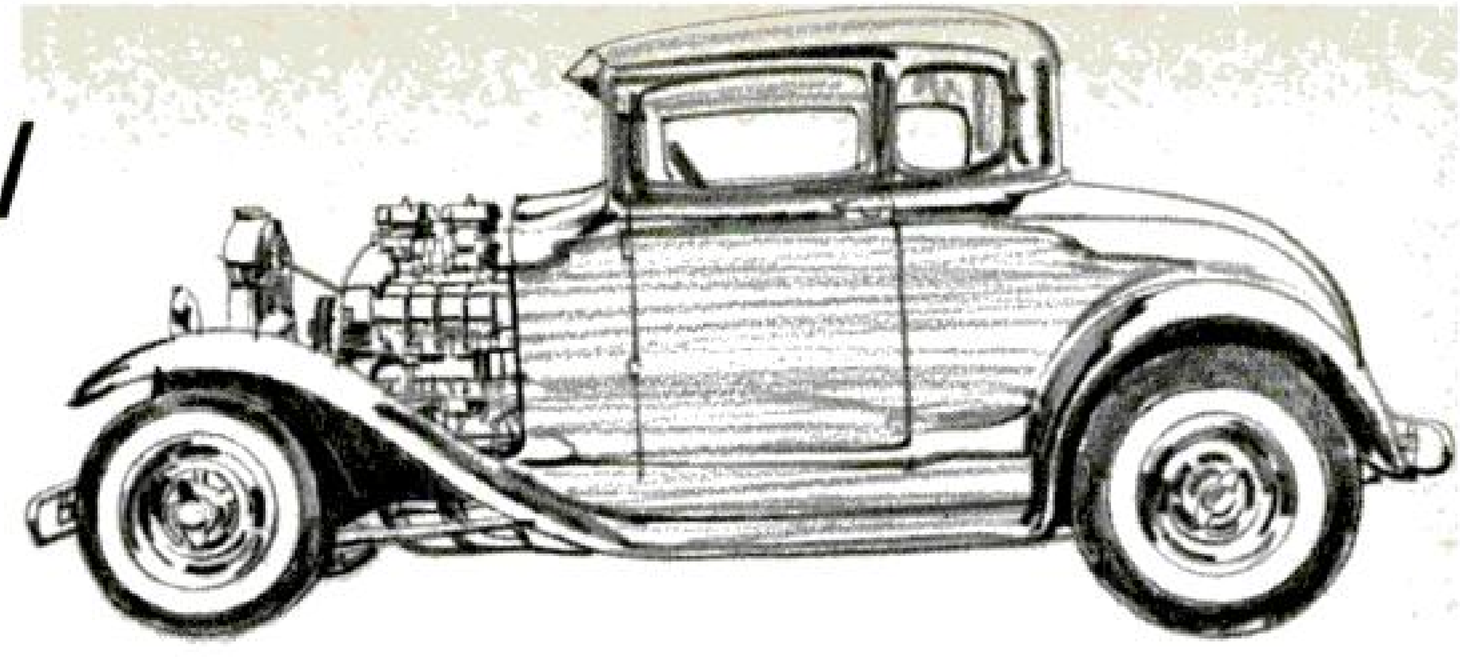
Urheberrechtlich geschütztes Material

DRAW THE HOT ROD



WIN A $595.00 COMMERCIAL ART SCHOLARSHIP — Find out if you have valuable, hidden talent for a career in commercial art! Draw the hot rod. Make your drawing larger or smaller than this one. Use pencil. Everyone who enters gets a free professional estimate of his talent. The art scholarship winner receives a complete course in advertising art, illustrating, cartooning and painting taught by America's largest home study art school, Art Instruction Schools. You'll receive individual professional instruction at home. High salaries and rewarding careers are waiting. Uncover your hidden talent now! Entries for this contest due by August 31, 1965. Amateurs only. Our students not eligible. Winner notified. Clip this coupon and start your drawing today. You may be a winner!

AI/ART INSTRUCTION SCHOOLS
Studio 7145 • 500 So. 4th St., Minneapolis, Minn. 55415

Please enter my drawing in your scholarship contest. (PLEASE PRINT)

Name ________
Occupation ________ Age ____
Address ________ Apt. ____
City ________ State ________
County ________ Zip Code ________

Accredited by the Accrediting Commission of the National Home Study Council

For Fun and Profit
FIX CLOCKS AND WATCHES

Imagine the thrill of making valuable timepieces tick again—often after other experts have thrown up their hands in defeat! Master craftsman H. G. Harris shows you how. His fascinating new HANDBOOK OF WATCH AND CLOCK REPAIRS gives you the same kind of thorough knowledge skilled watchmakers learn in years of apprenticeship.

Over 200 Show-How Illustrations

and job-tested instructions enable you to install hands, dials, crystals, mainsprings, winding stems . . . repair cases . . . rehouse fine old movements in modern cases . . . speedily cure many troubles by demagnetizing or cleaning! Harris makes you the master of every popular watch and clock, including pendulum and striking models, chimes, grandfathers, cuckoos, priceless French clocks, everyday alarm and electric clocks.

Friends Will Thank You for

restoring cherished timepieces, gladly pay $5 up to $50 or more. Handbook tells you where to buy parts, even where to send "overflow" work for repairs at wholesale rates as business expands! Earn even more by picking up fine old clocks at rummage prices, then restoring them for resale at handsome prices.

Complete Training Costs Less Than Profit on One Job!

See for yourself what profitable fun this hobby can be. You could spend over $100 on horology course and not gain half as much practical knowledge! Examine HANDBOOK OF WATCH AND CLOCK REPAIRS seven days on **money-back guarantee of satisfaction.** Rush only $4.95, less than price of a watch cleaning, to

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Dept. 461-P, 251 West 19 Street, New York 10011

EARN $10,000 A YEAR

Let us prove that around $4,300.00 a year is the starting pay for graduates of our DIESEL-AUTO TRAINING . . . they can quickly advance to the $10,000 a year. Play it safe . . . investigate the tremendous advantage of

SUCCESS INSURANCE TRAINING
THE GREATEST advancement in technical education during this century.
It means 98% of our grads placed . . . at higher starting pay . . . advanced much faster to BIG PAYING JOBS.
EARN WHILE YOU LEARN. We get you a part time job and housing.

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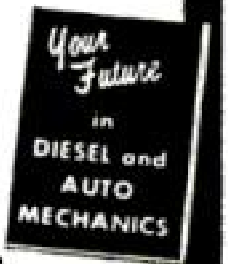

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1645 S. Grand, Dept. PS, St. Louis 4, Mo.

☐ DIESEL ☐ AUTO

LEARN-BY-DOING is the training method used for more than 25 years by the WORLD FAMOUS Bailey Tech.

Name ________ Age ____
Street ________
Town ________ Zone ____ State ____
Telephone ________

Urheberrechtlich geschütztes Material

The little old lady who only drives her car on Sundays puts the hardest wear on the engine -unless she uses her little old head and buys top quality motor oil

KENDALL MOTOR OILS

Kendall refines quality motor oils from the world's richest 100% Pennsylvania Crude Oil. Your dealer will recommend the one best suited to your engine, your driving habits and your pocketbook. When you start using Kendall Motor Oil, you get the extra margin of safety and the Economy of Kendall Quality.

RACING ENTHUSIASTS
We've printed eight vignettes of famous races run since 1903 in a little brochure titled "A Short History of Racing." You'll find it interesting and informative. Write for your free copy.

KENDALL REFINING COMPANY
Bradford, Penna. / Toronto, Canada

MGA. When hot, it drops to 20 pounds regardless of r.p.m. Could it be the oil pump, or what else can you suggest?"—Keith Erb, Sewickley, Pa.

This condition usually indicates too much wear on the oil pump, or the bearings, or both.

►*"How would raising the front end of a Chrysler-product car, by tightening the torsion bar, affect the wear of the steering mechanism and wheel alignment?"—A. B. Harada, Honolulu.*

Assuming you are talking about a road car—not a high-performance hot rod—don't raise it over an inch, unless you are a mechanical genius, or have more money than you need. The many factors involved in steering geometry and ride control would require an engineer to raise the front end substantially.

►*"I have a persistent engine miss at low speeds in my '64 Pontiac Tempest 6 with standard transmission. They have tried new carbs and all new ignition parts. Nothing seems to help. What can you suggest?"—Jim Anderson, Reno, Nev.*

This could be caused by a valve sticking, or lifter troubles, and/or leaks around the intake manifold or gaskets. If everything checks out, try the distributor-advance curve. If that's off, some basic changes are in order through your factory service representative—if you still have some warranty left.

►*"My 1963 Impala 283 V-8 with two-barrel carb and automatic has always had a stalling problem. The dealer can't solve it." —Nino Giannattasio, Lynn, Mass.*

Your carburetor could be too lean or too rich—probably the former because of incorrect automatic-choke action. Get a good carb overhaul by a specialist—the float may be set at the wrong level. And see that the manifold heat system is working. ■ ■

Got a question on autos? Send it to:
"Say, Smokey—" Popular Science
355 Lexington Ave., New York, N.Y. 10017.
Not every question may be used. Questions cannot be answered by individual letters.

Urheberrechtlich geschütztes Material

What if I'm laid off?
Will automation take my job?
How can I ever afford to retire?
Am I too old to change jobs?
Can I learn a new skill?
Could I succeed as my own boss?
How can I earn extra money fast?
Will my job ever pay more?

FINDS 3-WAY INCOME INSURANCE

"I earned $2,901.72 while learning locksmithing and now make $5000 a year—doubling my income. Worries about layoffs, retirement, more money are over for me—thanks to the Locksmithing Institute Course!"—Stanley Nowak, Saginaw, Mich.

MAIL COUPON NOW

Be a SKILLED LOCKSMITH

. . . and Solve ALL Your "FUTURE" Problems

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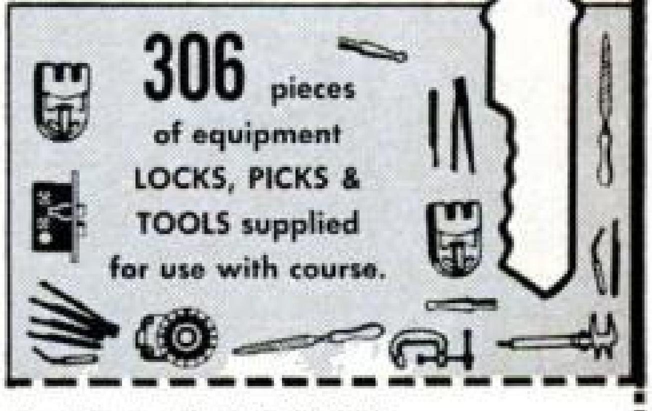

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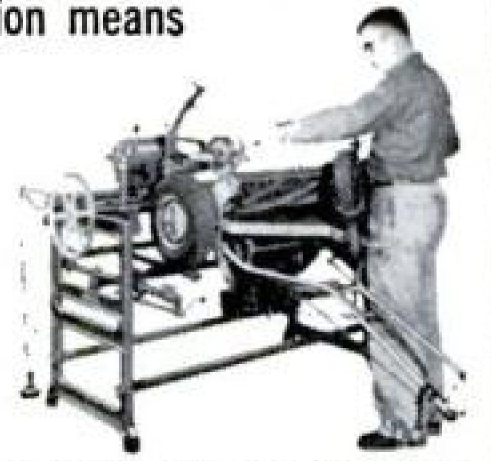

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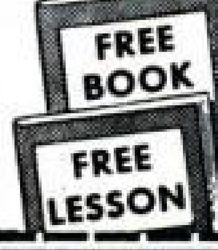

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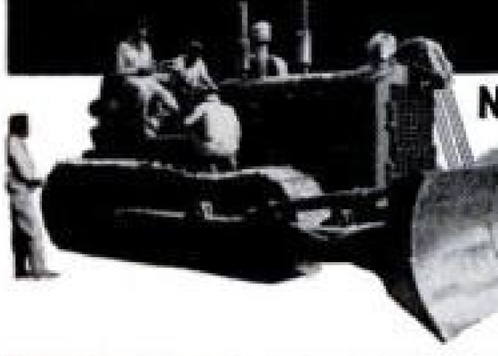

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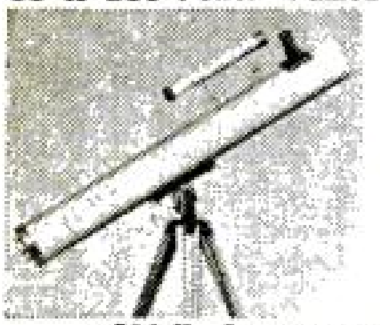

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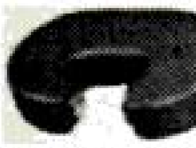

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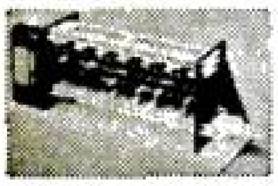

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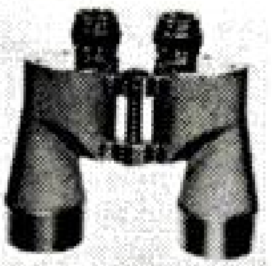

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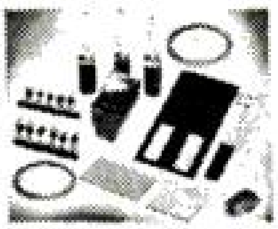

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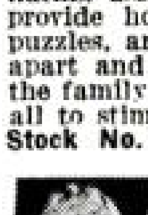

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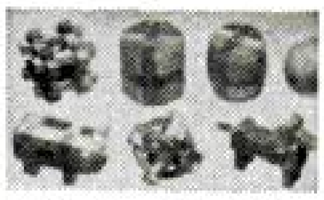

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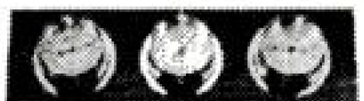

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SCIENCE *Newsfront*

BY WALLACE CLOUD, PS SCIENCE EDITOR

Mercury's long day—shorter than we thought

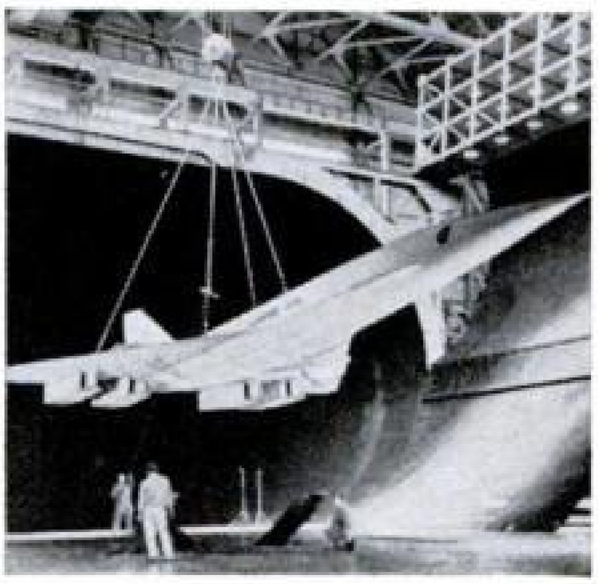
The textbooks will have to be rewritten again. They say the planet Mercury revolves once in its 88-day orbit, always with the same face toward the sun. But Cornell University astronomers, bouncing radar waves off Mercury with the 1,000-foot-diameter big dish at Arecibo, Puerto Rico, have discovered that Mercury spins a little faster. (Actually, they were trying to find out why the planet's temperature is uneven, instead of being hot on one side and cold on the other.) There's still uncertainty whether it turns once every 59 days, in the same direction as the earth's spin, or once every 46 days in the other direction.

The air-conditioned GI

A combat suit developed by the U.S. Army Materiel

Command, now being tested, keeps the GI comfortable in arctic or tropical weather. The backpack contains a thermoelectric generator that runs for eight hours on a quart of gasoline to blow heated or cooled air between the suit's insulating layers. With a transparent visor that flips down, the helmet includes earphones and a gas mask. It's called a "thermalibrium" suit.

Big wind for big model



A model plane over 60 feet long, with a wingspan of 29 feet, is being tested in NASA's giant wind tunnel at Moffett Field, Calif. It's a quarter-scale model of Lockheed's proposed 2,000-m.p.h. supersonic airliner. Tests so far show that the double-delta wing design benefits from a large "ground effect" (a cushion of air between the wing and the ground) during takeoff and landing. This helps to give the design good handling qualities in low-speed as well as supersonic flight. A U.S. aviation panel will eventually choose between this design and a proposed Boeing supersonic airliner with wings that change their angle in flight.

To stimulate the heart, electricity from the heart

An electrical heart pacemaker requiring no batteries or wires has been developed by two graduate students at Drexel Institute of Technology, Philadelphia. It takes electricity from the heart itself, then feeds electric pulses of the right kind back to the heart muscle.

Pacemakers implanted in the body are keeping many heart patients alive by delivering a steady flow of stimulating pulses to faltering hearts, but battery replacement requires surgery, and breakage of wires has been a considerable problem.

The prototype shown below was developed after Dr. Luther Reynolds, a biochemist at Hahnemann Medical College, also in Philadelphia, discovered that it was possible to produce a small flow

of electric current simply by placing two electrodes, one of platinum and the other of stainless steel, within the body. The two graduate students, Phillipe Racine and Harold L. Massie, built a circuit that would take this steady flow of about one milliampere at half a volt and use it to charge a capacitor, which is discharged about a

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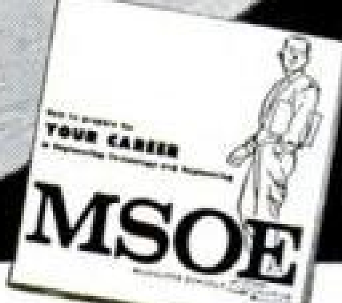

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hundred times a minute to yield 1½-volt pulses of five milliamperes—just right to stimulate the heartbeat.

The device was tested successfully on animals and then on human patients, during heart operations. Racine and Massie are now working on the next step: making the pacemaker small enough and rugged enough to be implanted in the body and last for 15 or 20 years without maintenance. In the end, it will be a capsule about the size of a quarter sewn directly to the heart, with no wires to break or corrode.

The researchers still aren't sure how the platinum and steel electrodes draw electricity from the tissues. While there are currents flowing in the body, the device doesn't tap them. Surprisingly, they think it's very likely that electricity is generated from chemicals in the body fluids in the same way as in a fuel cell.

Will new tobacco blends make cigarettes safer?

Cigarettes, at least those made in this country, may be getting safer. That's a conclusion from newly published research by scientists who have been among the most active in warning of the link between smoking and lung cancer.

Tests over the years "demonstrate a gradual reduction of 'tar' and nicotine for American plain as well as filter cigarettes; for some cigarettes the reduction ranges from 20 to 40 percent since 1960," reports a well-known foe of cigarette smoking, Dr. Ernest L. Wynder of the Sloan-Kettering Institute for Cancer Research, New York.

"Tar" from English cigarettes was about twice as cancer-producing as that of American cigarette smoke, in tests on mice by scientists at Roswell Park Memorial Institute in Buffalo, N.Y. The project was one of the few that have compared different types of cigarettes, including popular brands of American plain and filter-tip cigarettes, a denicotinized cigarette, and English brands.

The Roswell Park study relied on the standard technique of painting tar condensed from cigarette smoke on the skin of mice, and seeing how many skin tumors developed. Thirty-one percent of the mice receiving tar from three filter-tip brands developed skin tumors (definitely cancerous in eight percent), while 65 percent of the

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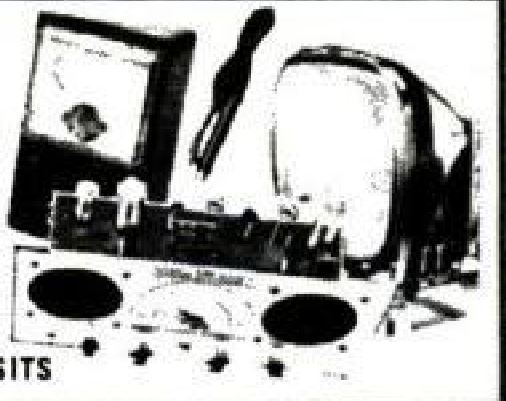

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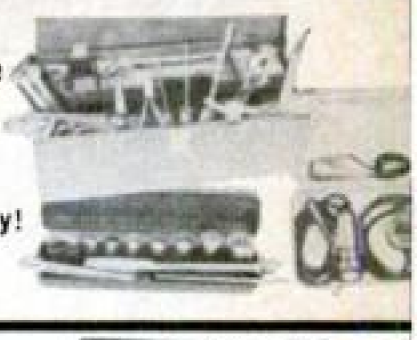

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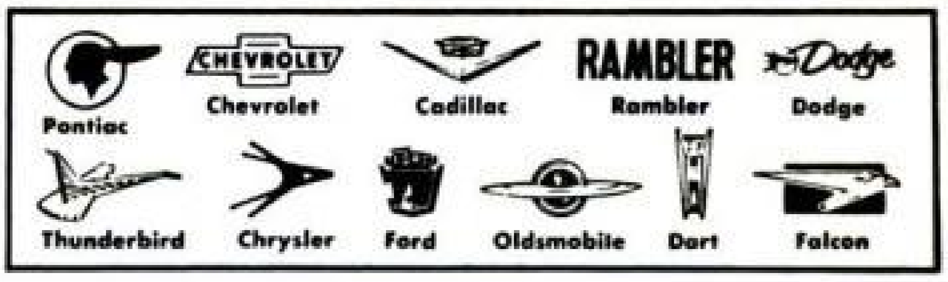

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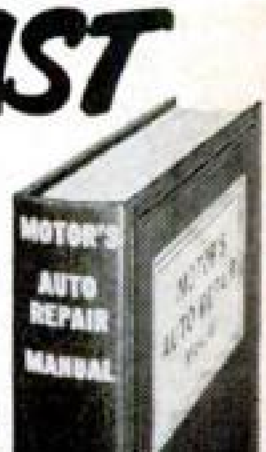

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mice painted with tar from equal numbers of cigarettes of three nonfilter brands developed tumors (cancerous in 27 percent). This was attributed to the fact that filtered smoke contains less tar.

Mice treated with tar from a denicotinized filter-tip brand developed the smallest number of skin tumors, 16 percent; only four percent were definitely cancerous.

Why did the mice that got tar from the nonfilter English cigarette develop about twice as many tumors as those exposed to tar from the same number of American nonfilter cigarettes? The researchers think it was because English cigarettes are made almost entirely of flue-cured, yellowish Virginia tobacco, and that this might help to explain why English cigarette smokers have a higher rate of lung cancer than Americans. American cigarettes typically contain about 50 percent air-cured, darker-colored Burley, the remainder being flue-cured Virginia and other tobaccos.

The effect of different kinds of tobacco on the cancer-producing activity of cigarette smoke was the main subject of the project at the Sloan-Kettering Institute. It showed that Maryland and low-nicotine Burley tobaccos produce less tar than other kinds, and that tar from Burley tobacco smoke produces fewer skin tumors on mice than equal amounts of tar from other tobaccos. Burley tar was also found to contain less of some chemicals known to be cancer-producing, such as phenol and benzpyrene.

The lowest percentage of tumors resulted from the smoke of "reconstituted tobacco," or "homogenized leaf"—a paperlike product made from tobacco dust and ground tobacco leaf and stems. Next lowest was a standard tobacco blend cut more finely than normal cigarette tobacco.

Tobacco additives such as copper nitrate reduced the amounts of phenol and benzpyrene in cigarette tar, with a consequent reduction in the number of skin tumors produced on mice.

The Sloan-Kettering scientists speculate that American cigarette manufacturers have been using increasing proportions of the low-tar tobaccos and reconstituted tobacco. It remains to be seen, they point out, whether these changes will show up as a lower death rate from lung cancer. ■ ■

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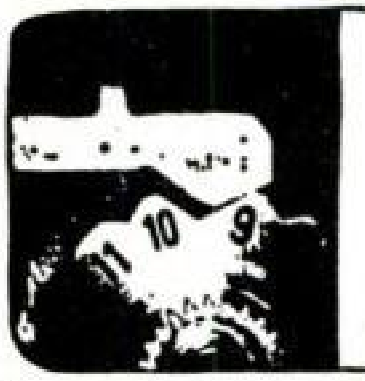

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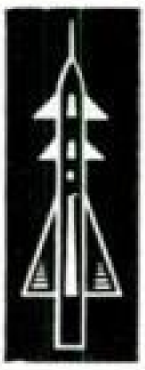

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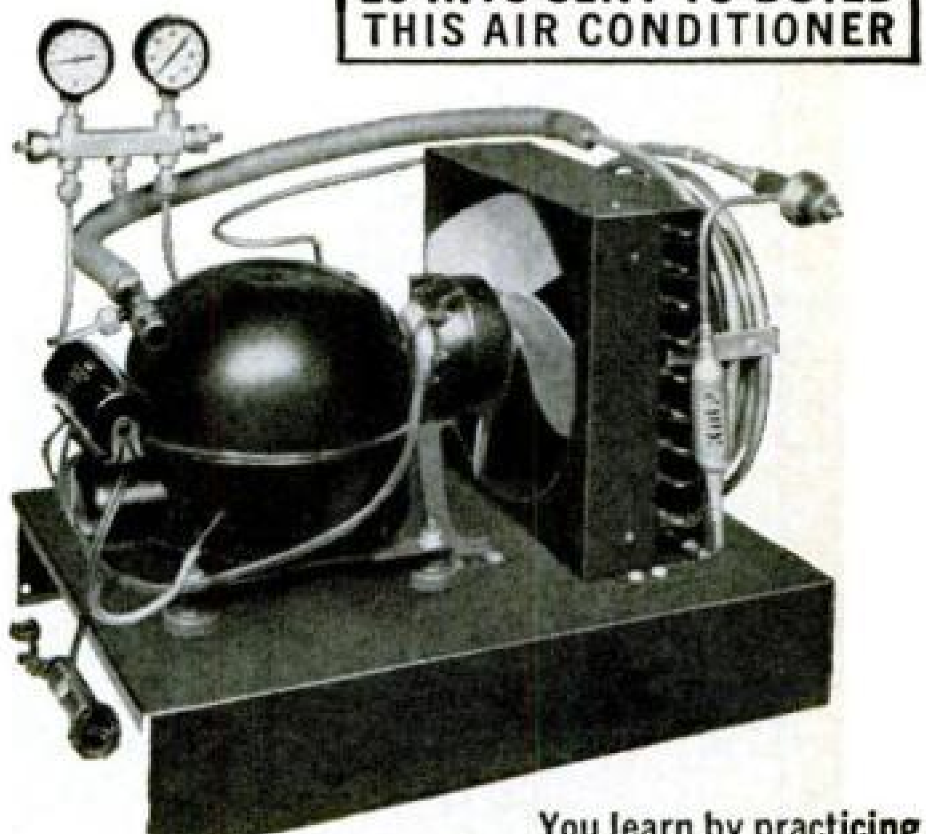

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GETTING AHEAD

A monthly column to help you prepare yourself for a better job

By Dr. Lewis R. Fibel

THANKS to G. H. Melvin of New Orleans for his interesting solution to how you can get the cultural benefits of a college degree to get ahead on the job when you can't quit the job to go to college: Earn a Bachelor of Liberal Studies at home from the University of Oklahoma (Norman). You enroll in broad areas of study (humanities, social sciences, natural sciences), not separate subjects. Pretesting screens you for your own level of attainment—you needn't repeat subject matter acquired through prior learning or experience, and you complete your assigned readings (selected for you individually) at your own pace. You attend a three-week intensive-learning seminar on campus three summers. Finally, on completing your program, you take exams for the degree.

If you find the idea fascinating, as I did, write the Coordinator of the BLS Program at the University for details.

"Where can I learn auctioneering? Are there schools?"—J.P.H., Carthage, Ill.

Most auctioneers "pick up the trade" by working with experienced auctioneers, but there are schools: Reisch Auction School, 14 Oak Drive, Mason City, Iowa; Missouri Auction School, 1330-05 Linwood Blvd., Kansas City, Mo. 64109; Ft. Smith Auction School, Ft. Smith, Ark.; Western Col. of Auctioneering, 213 N. 30th, Billings, Mont.; Dell School of Tobacco Auctioneering, 20 Bell, Kingston, N.C.

"I was trained as a photo interpreter in the Army. Is there a demand for such work in civilian life?"—L.J.B., Chicago.

The new field of photogrammetry—the science and art of obtaining reliable measurements by photography—is closely related to photo interpreting. The most common application is preparation of topographic maps. Photo interpretation is also used in geology, soil science, engineering, forestry, wildlife management, agriculture, urban analysis, archeology, hydrology, geography, and other fields.

"What schools in the West teach electric-motor repair?" —N.H., Bellevue, Wash.

Many trade schools for electricians give instruction in motor rewinding and repair. In any event, you'd have to start with some basic knowledge of electricity. The following schools offer courses for electric-motor repairmen: Bakersville College, Bakersville, Calif.; Laney Campus, Oakland (Calif.) Junior College; Emily Griffith Opportunity School, Denver, Colo.

"I wanted to be a doctor, but four years of college is my limit. Shopwork has always been my hobby. Should I forget college and enter a trade school?"—J.M.I., Rochester, N.Y.

Why not combine the medical and shop fields? New York University has a new four-year program to train prosthetists (who design, make, and fit artificial limbs) and orthotists (who work with braces). There are many openings for both—in university teaching and research, hospitals, rehabilitation centers, government agencies, and private clinics.

Salaries start at $6,000, increase to over $12,000 a year. Write the Department of Physical Ed., New York Univ., Washington Sq., NYC 10003, for details.

"Where can I get training and employment in scientific illustration?"—B.M., Pittsburgh.

There is considerable need for technical illustrators—specialists in illustration for technical manuals, reports, and sales literature for electronics, aircraft, and other industries. Other specialists illustrate medical or scientific textbooks, articles, and advertisements.

Most large companies (IBM, General Motors, RCA, Curtiss-Wright) employ technical illustrators, as do many art studios.

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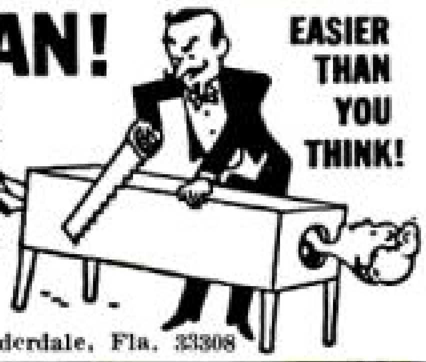

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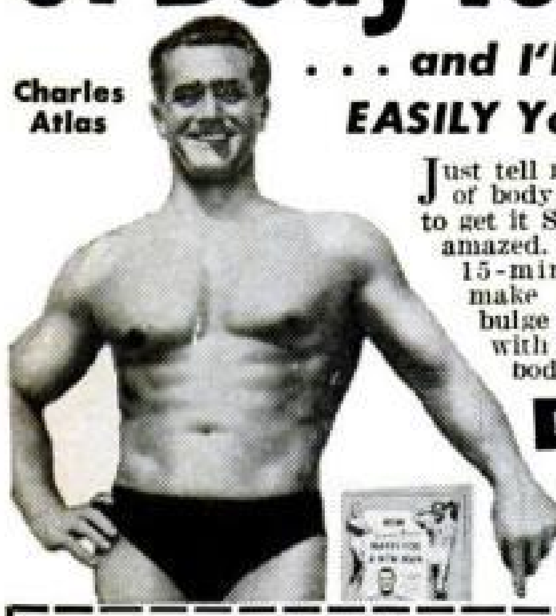

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Many illustrators free-lance, working in their own studios.

Medical illustration is offered at the U. of Calif. (San Francisco); Medical College of Ga. (Augusta); U. of Ill. (Urbana); and Ohio State U. (Columbus). Any good commercial-art course should prepare you for technical or scientific illustration if you have the talent.

"Auto mechanic vs machinist: Which promises the better future?"—S.B., Montreal, Can.

My latest figures list auto mechanics' earnings (excluding overtime) from $2.15 to $3.38 hourly—depending on area. Advancement opportunities: foreman, service salesman, service manager of repair shops; owner of garage, gas-station operator; car dealer. The number needed is expected to increase due to more cars, more complexity in construction, more farm mechanization.

Machinists averaged $1.96 to $3.49. They may advance to foreman and other supervisory jobs, (with more training) tool and die makers or instrument makers, and owners of machine shops. A moderate increase is expected as metalworking expands.

"I'd like to be an industrial traffic manager. Where can I study?"—C.M.U., NYC.

Increasingly, college graduates are preferred for traffic management—arranging quick and safe transportation of raw materials and finished products at minimum cost. Aim for a business-administration degree, with a major in transportation. Over 50 colleges offer courses.

Write the registrars at colleges of your choice. Many two-year colleges offer courses, too.

"Are there courses for studying to be a custodian-engineer?"—C.E.B., Hoven, S.D.

The Apex Tech. School, 52 E. 9th St., NYC, offers a course slanted toward preparation for the exam for a New York City license as a custodian-engineer.

The job of stationary engineer is similar. The Internat'l Corres. Schools (Scranton, Pa. 18515) offers home-study courses for this. The Internat'l Union of Operating Engineers (1125 17th St. N.W., Washington, D.C. 20036) may have a list of trade schools you could attend.

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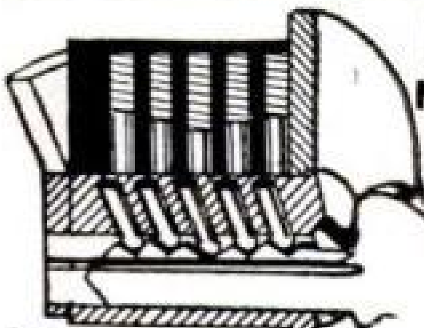

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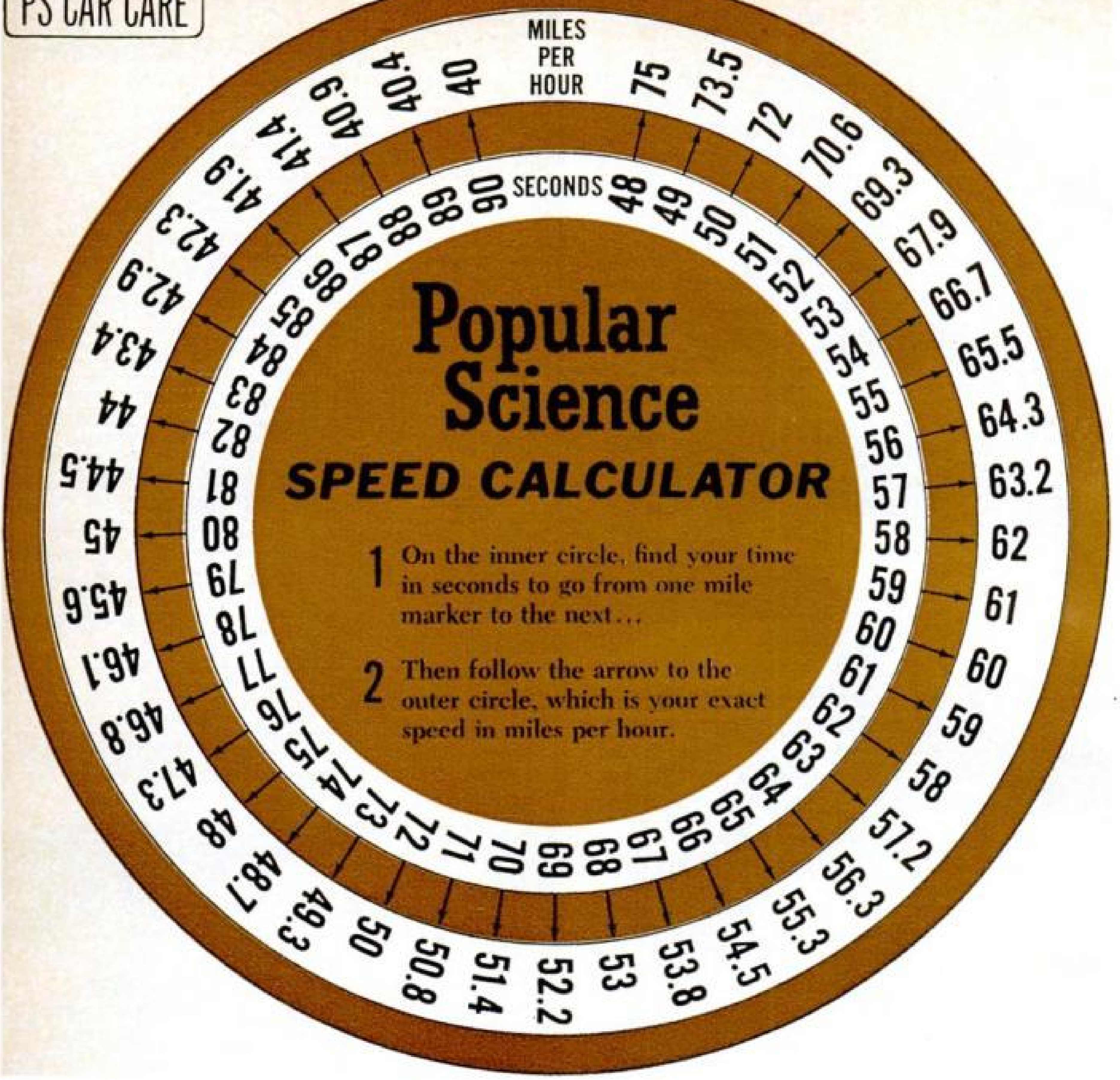

Keep Tab on Your Speedometer

Use this simple device, a watch, and the familiar milepost to check your speed down to one decimal place

By George S. Bondor

A STOPWATCH, or a wristwatch with a sweep second hand, a cooperative passenger, and the Popular Science Speed Calculator shown above will enable you to check the accuracy of your car's speedometer. Mileposts found on turnpikes provide convenient reference points. Simply cut out the round dial above and paste it to a piece of cardboard. Ask a friend to do the timing while you drive at constant speed from one milepost to the next. For absolute accuracy, have him sight along the vent-window post and click a stopwatch or check his wristwatch when you pass the first milepost. He should retain his position until he sights the next milepost and checks the watch. To convert to m.p.h. the seconds it took you to travel a mile, just follow the directions on the Calculator.

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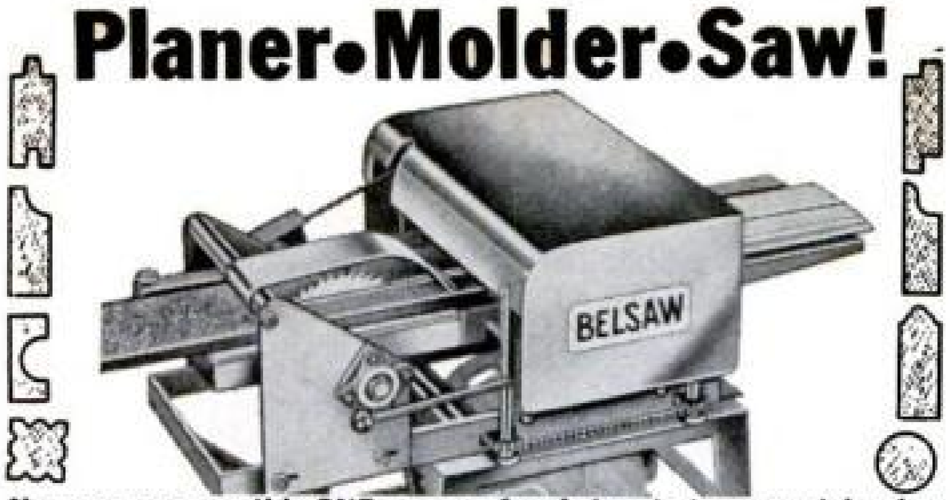

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Detroit report...

WILL CHRYSLER EVER BUILD GAS-TURBINE CARS? The schedule called for 200 Dodge turbine cars to be produced this fall, but that idea has been shelved. More development work, apparently, is needed on both power plant and car. Repeated delays in the program are causing a lot of irritation; one irate--and influential--stockholder accuses the corporation of wasting its competitive advantage.

Other automotive gas-turbine programs are well under way at the research facilities of most other engine makers. The most prominent contenders: Ford, Allison Division of GM, Caterpillar, and International Harvester. These tend to concentrate on large power units—500 hp. and up—intended for trucks and off-highway equipment. Caterpillar is very active and also most secretive about gas-turbine development—the heavy-equipment manufacturer now has about 100 engineers working full time on the turbine program.

The modern perimeter frame is threatening to kill unit-construction bodies in full-size cars. Five years ago the industry seemed on the verge of adopting frameless bodies throughout. All the compacts and all but one of Chrysler's full-size cars were designed with unit-construction bodies during a period that began with the 1959 models. Then came the big reversal with Buick, Olds, Pontiac lines going back to separate frames on '64s. The next switch (for '67) will be made by Thunderbird. Lincoln will follow suit a year later. And now the word is out that the big Chrysler Corp. cars (Plymouth, Dodge, and Chrysler) will also switch soon after that.

Radial-ply tires for the aftermarket are already offered by four major American companies: Goodrich, Firestone, Goodyear, and U.S. Royal. Many 1966 cars will be available with radial-ply tires as a factory option. The main difference between radial-ply tires and ordinary tires lies in the use of one or two right-angle cord plies and several firm layers of breaker cords under the tread instead of the usual four cross-plies at 36-40 degrees. The breaker plies may be steel, rayon, or fiberglass. This "belt" reduces tread flexibility, so that tire contraction in the contact patch is avoided, the tire runs cooler, rolling resistance is lowered, and wear is drastically reduced. Tire life is almost double in city traffic, and at highway speeds the radial-ply tire has an even greater advantage. Radial-ply tires also have higher resistance to side forces, so that the car tends to run straighter on the straighs and develop higher cornering power on turns. The standing wave, which occurs in conventional tires at high speeds, is completely eliminated. With full-size cars, it is estimated that radial-ply tires give a 10-15-m.p.h. extra safety margin. With lighter cars, the advantage is greater. Any drawbacks to radial-ply construction? Only two: poor shock cushioning at low speeds (with attendant noise) and high initial cost (special machinery is needed and manufacture takes longer).

The design of the front-drive Olds is about to be frozen. Front coil springs have been discarded for torsion bars coupled to the lower control arms. Rear springs will be tapered single-leaf (as on the Chevy II).

The V-8 engine used by Kaiser Jeep in the Wagoneer is an American Motors 327-cu.-in. power plant. The engine is coupled to GM's Turbo-HydraMatic transmission, giving the utilitarian station wagon one of the smoothest power trains on the road. It may be significant that Kaiser chose to buy the power unit from American Motors when Chevrolet can supply one of identical size (and does—to Checker and Studebaker). This is the latest in a series of moves that have connected Kaiser and Rambler in automotive ventures all over the western hemisphere.

Stablemate for the Mustang is on the way. As reported last January, Ford will bring out a four-wheel-drive utility vehicle. It will be called the Bronco, and is to be built in Ford's Wayne, Mich., assembly plant.

Jan P. Norbye
Automotive Editor

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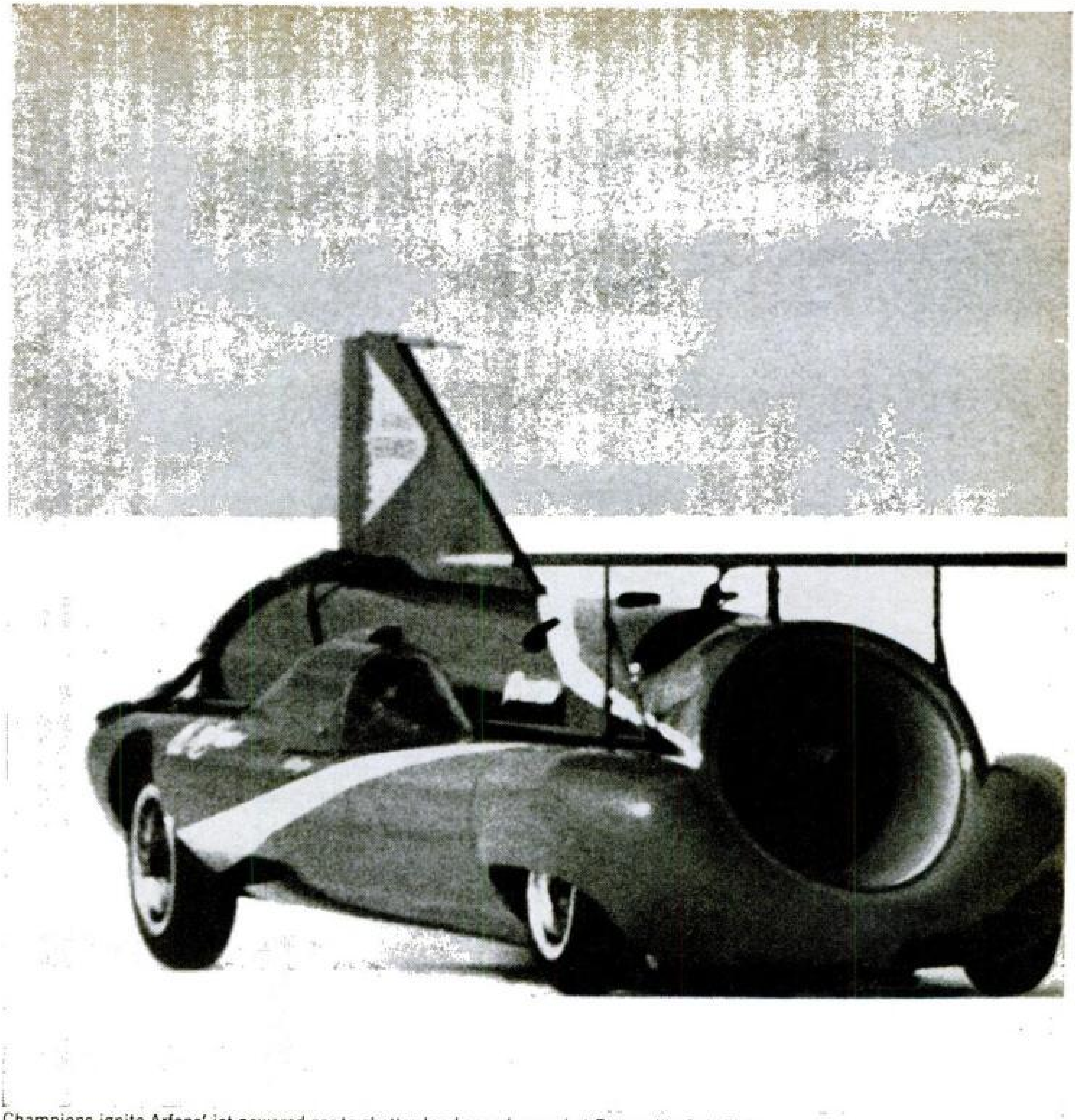

Champions ignite Arfons' jet-powered car to shatter land speed record at Bonneville Salt Flats

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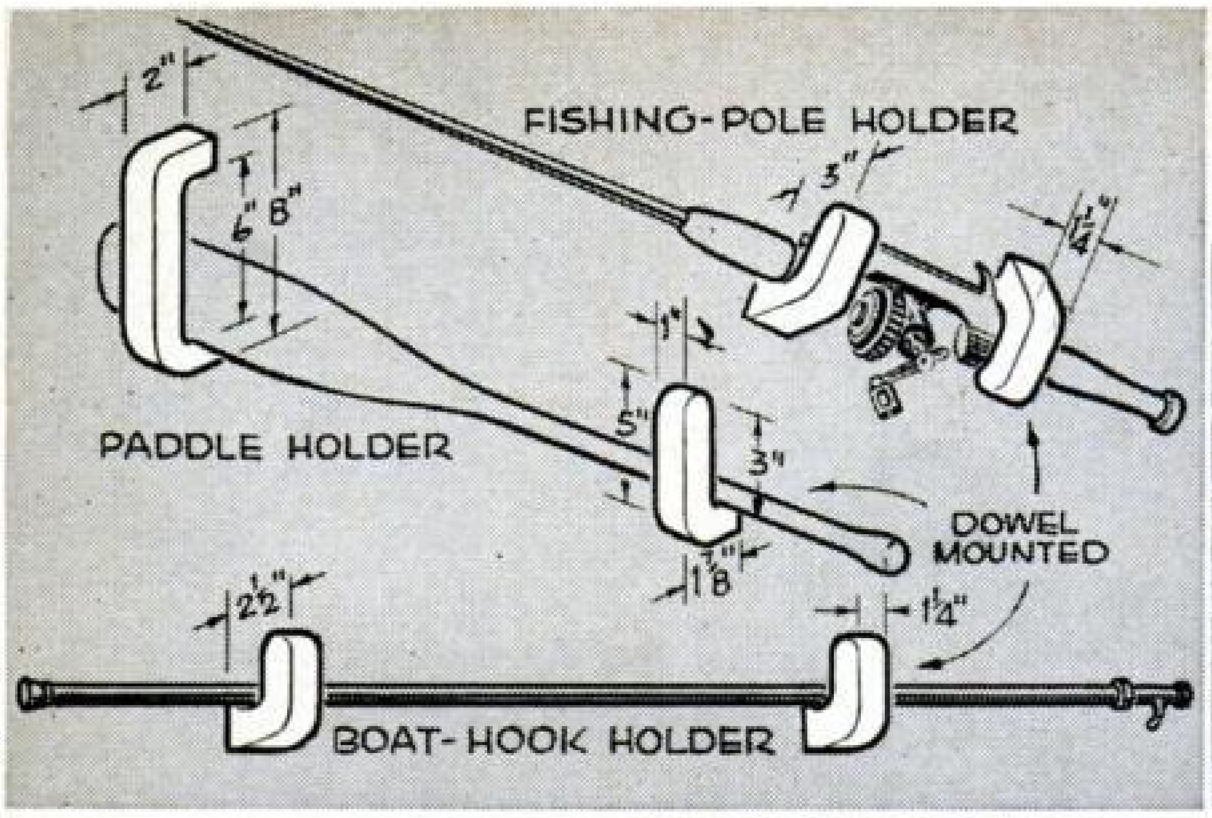
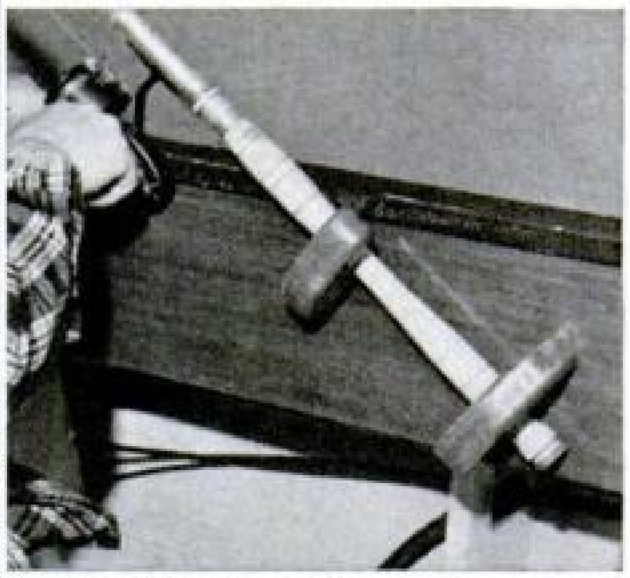
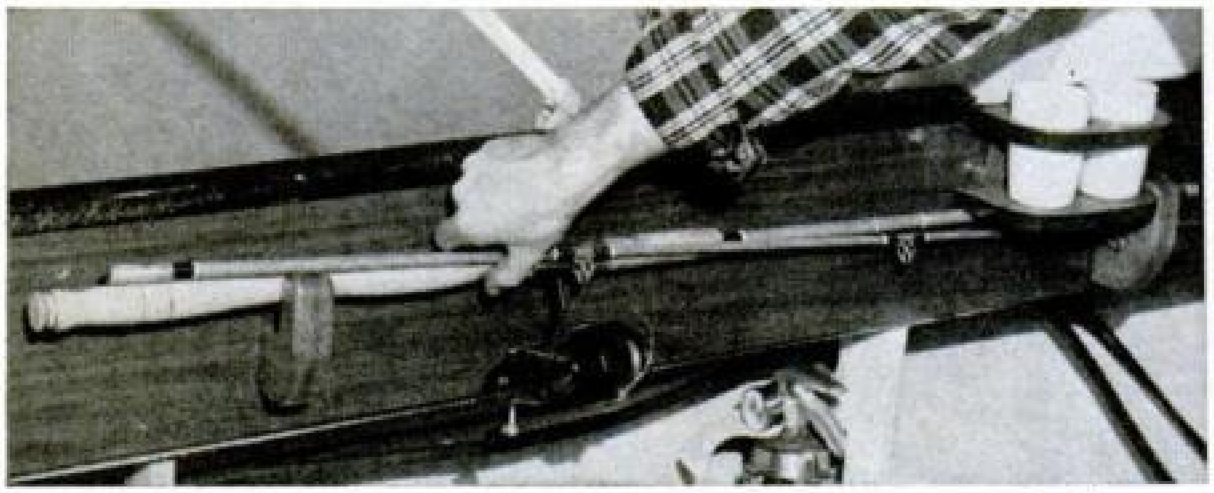




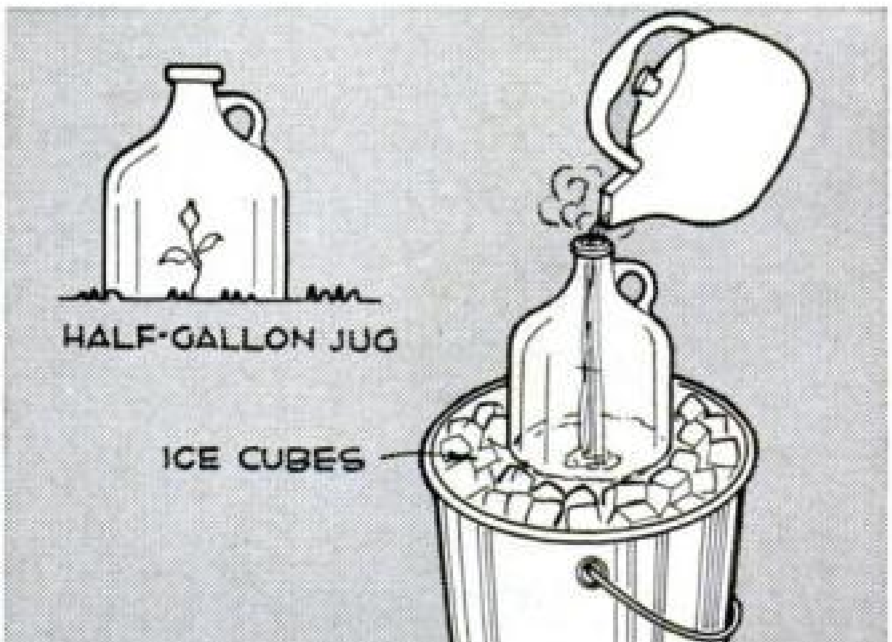


Holders for paddles, rods, boat hooks

A few simple cuts on a jig- or band-saw are all you need to turn out these mahogany boating holders. Measure your equipment first so the curve and depth of the cuts fit each piece of gear. That way, the rods won't bounce to the deck when your boat slams a wave. Mount holders with ⅜" wood dowels and quality marine glue. Stain to match the coaming finish, and add a coat of varnish. Set fishing-pole holders at about a 30-degree angle as in the photo.—*Victor W. Kondra, Temple City, Calif.*

Paint pail has many other uses

Use a can opener to cut the tops off gallon paint pails when you know all of the paint will be used. They'll make good paint buckets during the painting job. Cleaned up with paint solvent, they become handy containers around the house or sand buckets for children.—*R. S. Tupper, Canton, S. D.*



Easy way to turn jugs into greenhouses

Protect your frost-tender plants by using a simple greenhouse made by removing the bottom of a gallon jug. Chill the jug on ice cubes after you score around the bottom with a glass cutter. Then pour boiling water on the glass. The bottom will come off without messy splintering or jagged edges.

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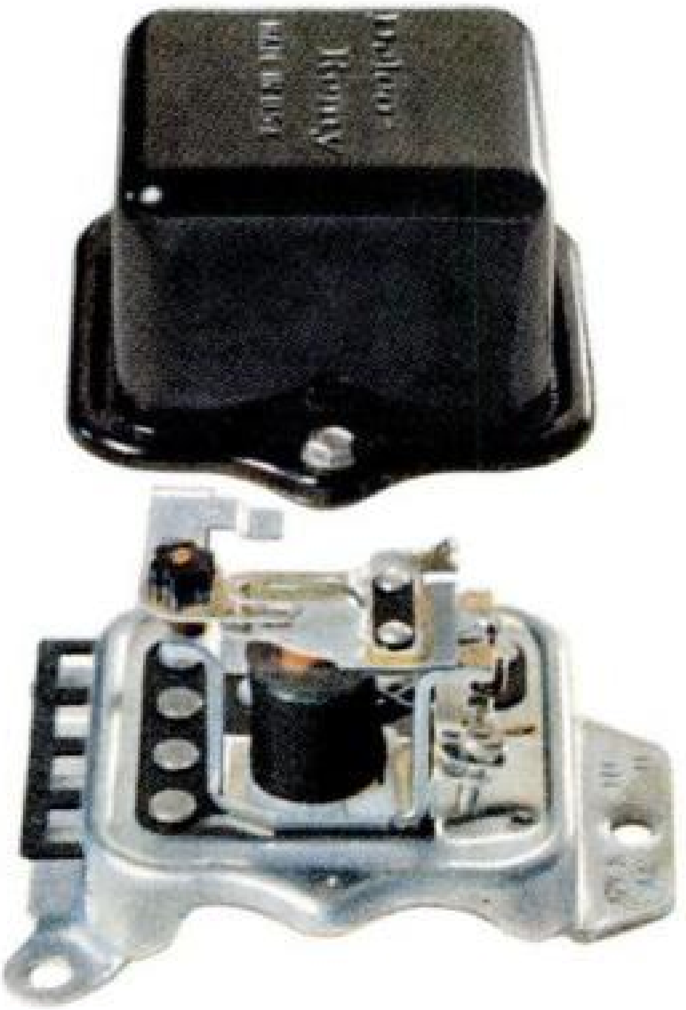

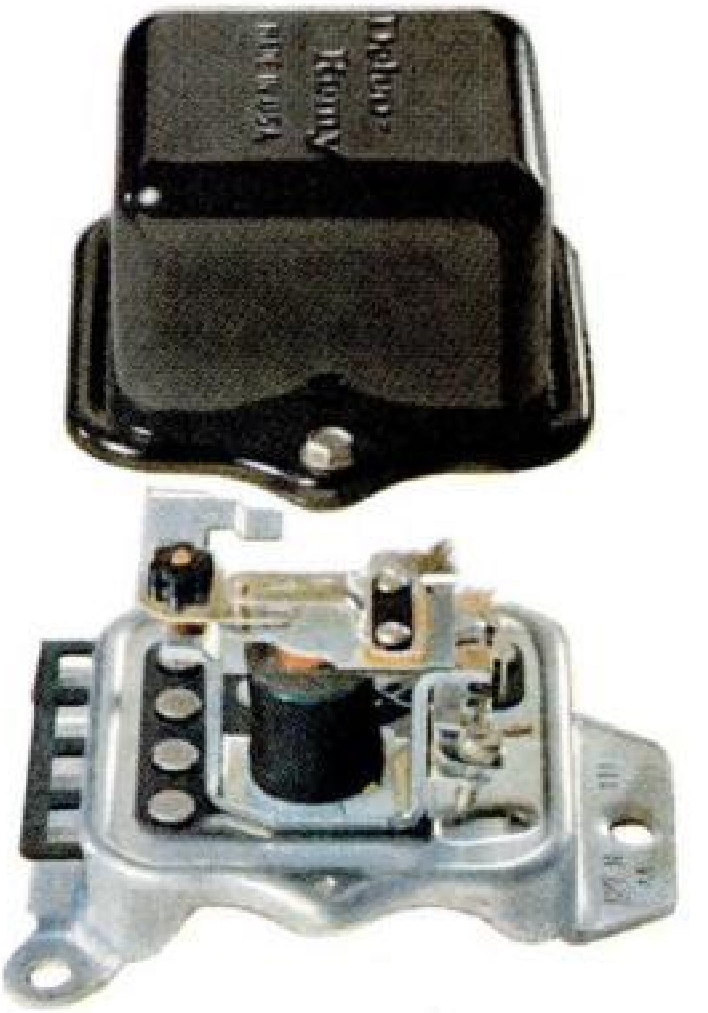

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Popular Science Monthly
REG U S PAT OFF

Detroit's Secrets for 1966

You'll be seeing new engines, bigger compacts, some styling surprises

By Jan P. Norbye

BIG things are happening in Detroit. Not only will 1966 cars have more power, sturdier chassis, sportier looks, and more luxurious equipment—they'll be safer. At the same time, some great engineering novelties are reaching the production stage:

- Oldsmobile is introducing its front-drive Toronado

CONTINUED

Front-drive Olds Toronado has distinctive styling, seats four, will cost $4,500 and up.

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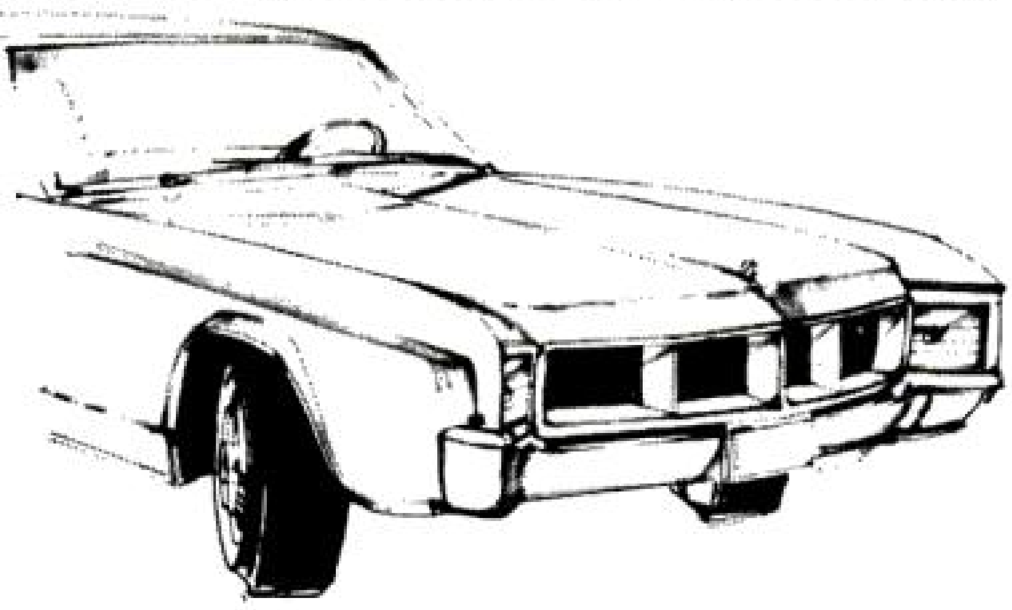
Many safety features will become general in the upcoming

LINCOLN *Continental changes its style by adding sculpture lines in the body panels.*



BUICK *Riviera gets rectangular-frame grille with wide gaps, new concealed headlights.*

(called Holiday in our April preview).

• Pontiac will bring out a six-cylinder Tempest engine with a belt-driven single overhead camshaft.

• Chrysler is preparing a 400-hp. "street" version of the 426-cu.-in. hemi-head V-8 for several lines.

• Mercury is pushing for early introduction of its experimental "wrist-twist" power-steering system [PS, April].

A number of safety features—rear seat belts, recessed instrument panels, better interior padding, dual-circuit brake systems—will become general. Nylon tires that are immune to flat spots will be readied, and radial-ply tires will be optional on some cars.

The industry is slowly working toward roll-over bars as an integral part of the body structure, and collapsible steering columns to lessen injuries on impact. Disk brakes will be optional on many cars, and drum brakes will be improved as forecast ["How Brakes Will Be Better Than Ever in '66"] in June PS. The industry has perfected inexpensive smog-control devices for those areas that require it.

Many industry spokesmen regard high-performance engines as a safety factor, and all manufacturers agree that the driver who wants more power shall be able to buy it:

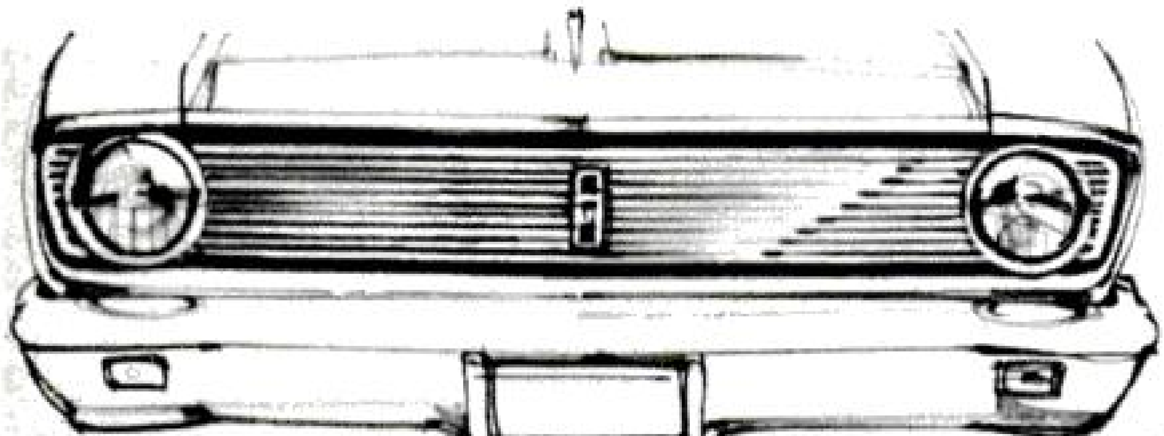
Chevrolet will enter the field of the Tempest GTO, Olds 4-4-2, and Skylark Gran Sport with a Chevelle-based car—the Maverick. Its 396-cu.-in. V-8 will have 375 hp.

Ford Fairlane and the new Comet Capri will be available with high-performance 390-cu.-in. Thunderbird V-8s.

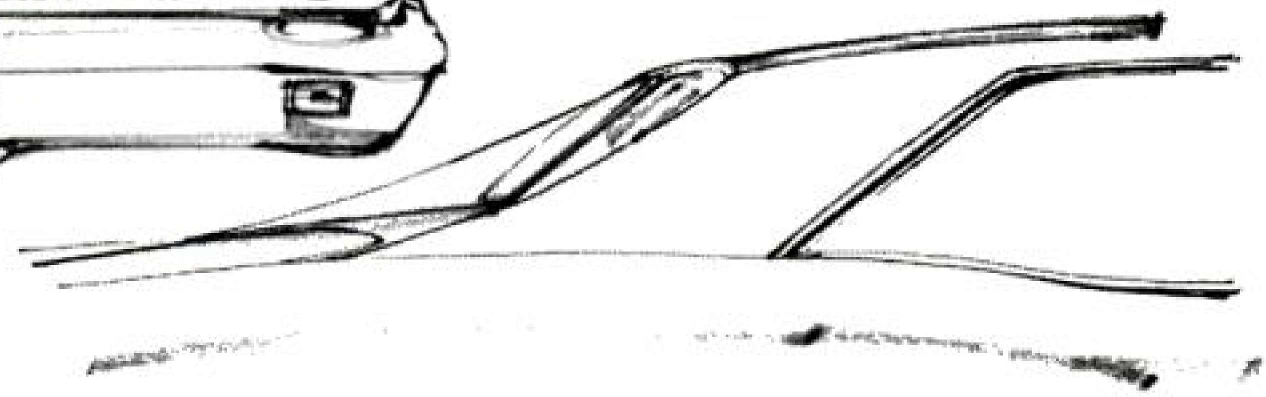
American Motors is designing a larger V-8 (biggest Rambler now has 270 hp.) with power output well over 300 hp.

Ford's 427 cu.-in. V-8 will be optional in several lines.

The Lincoln V-8 will be bored out from 430 to 462 cu. in., and Mercury will have a Thunderbird-based 410-cu.-in. engine.



FALCON *gets completely new body shell with curvy lines. The hood is lengthened and deck lid shortened.*



PONTIAC *Grand Prix gets new rear-window treatment with flatter glass set in the same sweeping roof line.*

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cars; there will be a complete new look for the compacts

FORD *Galaxie has horizontally split grille, minor changes in fenders and roof lines.*

PLYMOUTH *Satellite has stacked headlights, parking lights in grille, new fender lines.*

Imperial's power unit will grow from 413 to 440 cu. in.

Cadillac will raise power output from 340 to around 365 hp., but displacement will stay at 429 cu. in.

New look for the compacts. After six full production years, the Falcon gets its first complete restyling. The new unit-construction body stresses the Falcon's relationship to the Mustang, with a longer hood and a shorter deck lid. Wheelbase will grow to 111 inches, overall length to 184, and all interior dimensions will increase. Curved side glass gives narrower doors, wider seats.

Chevrolet's answer to the Falcon was the Chevy II, brought out for '62. It has always played second fiddle to the compact from Dearborn, but it will be a different car for 1966. Gone is the boxy look—its new lines will be smooth and flowing. With a new and smaller grille, single headlights, and simple, round tail lights, overall it suggests a front-engined Corvair. The most powerful Chevy II will pack the 300-hp. Corvette engine.

The big compacts are approaching full size, and the smaller compacts will soon be intermediates. The Comet will even come in two sizes next year. The larger (Capri) will have a 116-inch wheelbase (it's now 114), share a common basic body with the Fairlane, and look a lot like a Chevelle, right down to the rear fender kickup. The smaller Comet will be close to the Falcon in general proportions, but will have many styling features in common with the Capri, including a horizontally split grille, stacked headlights, curved side glass, and an instrument cluster grouped directly in front of the driver.

Ford's Fairlane will be built on the 116-inch wheelbase and look so much like the Galaxie that even Ford engineers have to look twice to tell them apart. There will also be a convertible Fairlane for the first time.

Most of the sheet metal in the B-O-P compacts will be new, and the sharp

CONTINUED

COMET *will come in two sizes; larger version revives Capri name (last used by Lincoln in 1956). Use of stacked headlights and horizontally split grille fails to eradicate the car's resemblance to the Chevelle.*

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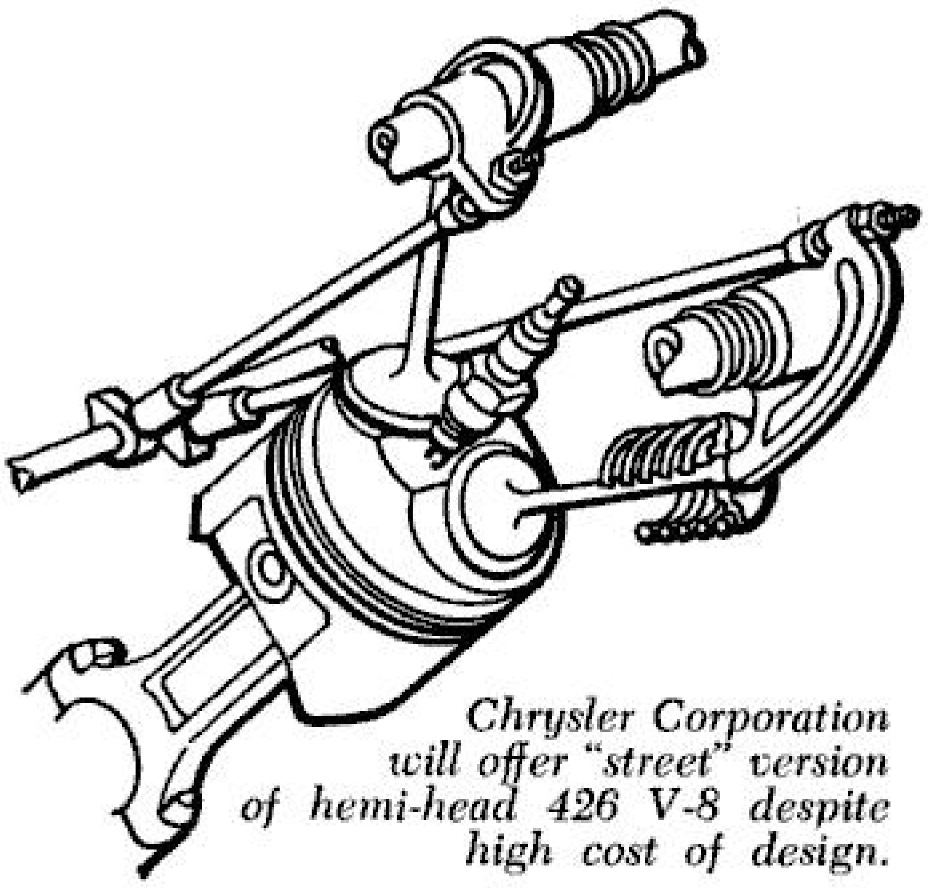
More in-line sixes are among the widespread engine changes



Chrysler Corporation will offer "street" version of hemi-head 426 V-8 despite high cost of design.

lines of the present bodies will be softened. The style leader will be a new two-door hardtop with a flowing roof design. A four-door hardtop will be added to all lines for the first time.

The lower-priced Buicks and Oldsmobiles will stay with V-6 engines; Pontiac and Chevrolet with in-line sixes. The new Tempest engine has an overhead camshaft, in-line valves (with finger followers) giving wedge-type combustion chambers. The design assures high volumetric efficiency, saves weight, and cuts manufacturing costs. The belt camshaft drive is silent, and Pontiac has enough confidence in belt durability to place the single-OHC six in mass production.

Where the action is. The big news from Oldsmobile is the front-drive Toronado, a two-door hardtop in the Thunderbird/Riviera class. The engine is a 385-hp. 425-cu.-in. V-8 driving the front wheels via a Turbo-HydraMatic transmission.

The Toronado has a very low look, giving an impression of great road-hugging ability. It has a large front overhang and a very short rear deck flowing smoothly from a fresh fastback design reminiscent of both the Avanti and Jaguar's E-Type. A highlight crease is pressed into the side sheet metal about five inches above the bottom edge of the body; it follows the bottom contour, around the full wheel cutouts, from bumper to bumper. Pop-up headlights, located inside the hood, raise when turned on. They don't roll, like the Corvette's, but swing straight up.

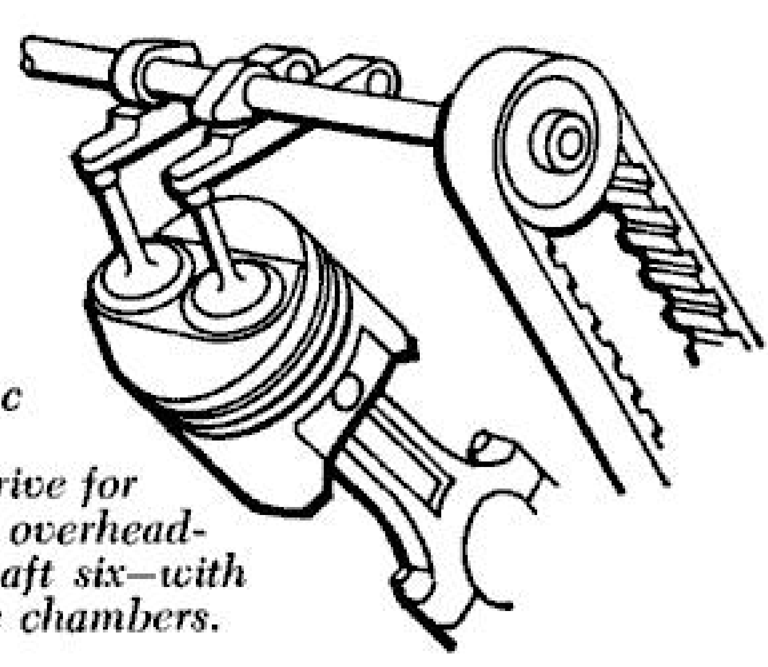
The Riviera shares its basic body and will have the same roof line, but there's little obvious resemblance. The Riviera lines are closer to the regular Buicks', with a definite fender kickup. It has a new, unique grille—a wide-gapping rectangle bracketed by running lights set on the inside of the leading fender edges. A new system of disappearing headlights is used.

The Buick is shorter, retaining its 117-inch wheelbase while the Olds has a 118.5-inch wheelbase. There are no vent windows in the front doors on either car, as GM has come up with a "flow-thru" ventilation system.

No new T-Bird yet. Ford has not reacted to the GM invasion of the Thunderbird market. The 1966 model will continue with its present body style and a minimum of sheet-metal changes. But an all-new Bird is due for 1967.

There will be visible changes on the Lincoln, now undergoing the greatest styling revision since the "classic" look was introduced in 1961. A two-door hardtop will be added.

Changes at Chrysler. Chrysler will concentrate on Belvedere and Coronet. Both will sport all-new sheet metal, for a slicker edition of the 1965 styling theme. The car to watch is the Dodge Charger—a full fastback for four persons



Pontiac chose belt drive for single overhead-camshaft six—with wedge chambers.

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on the regular 117-inch Coronet wheelbase. It is based on the Charger II unveiled last winter.

Valiant and Dart are not in for big styling changes, but refinements in front treatment will brighten up the Valiant and tone down the Dart. The rounded slope-shoulder styling will be replaced by straighter, sharper lines for a more boxy look.

The full-size Dodges and Plymouths will get the usual new grilles and reworked front and rear fenders; there'll be similar treatment for the Chrysler line.

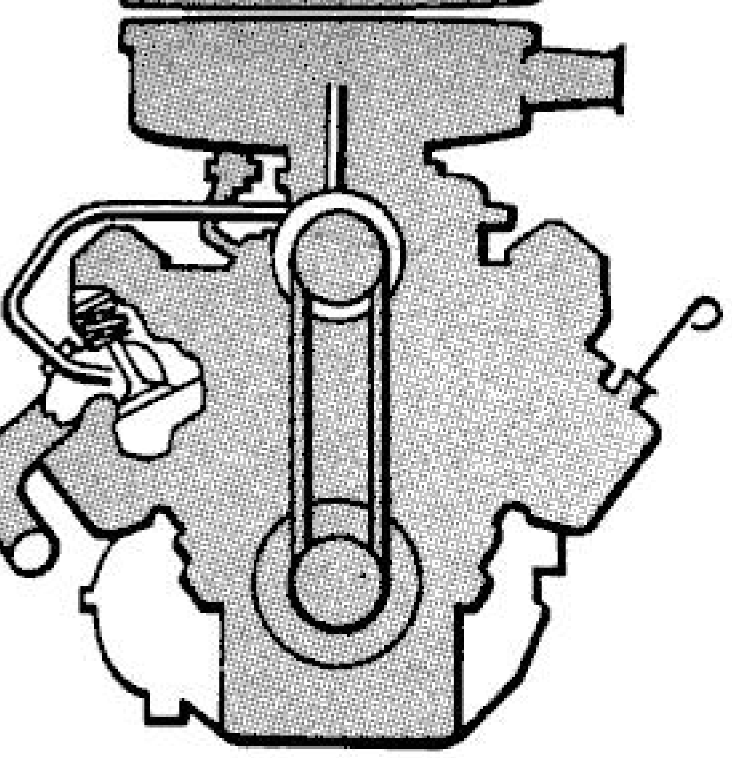
Reports that the Imperial would be built on the regular Chrysler body were premature. The Imperial will have a minor facelift for 1966 and continue with separate frame and body.

Rambler discovers the fastback. Most of the changes at American Motors will be small. The company says its styling is not to blame for the lagging sales—it's the economy image that's hurting Rambler. There are, however, two new models with Marlin styling in the works, an Ambassador called Marlin II and a Tarpon-like fastback on the 106-inch American wheelbase. All Ramblers will get new grilles and trim, and the hardtops will have a stretched-out roof line that approximates the current styling vogue.

Careful GM styling. When things are going great, you don't change the formula. The full-size GM cars will have some refinements in styling and some added power-train options, but that's all.

The concave rear window on Pontiac's Grand Prix will be replaced by a flatter piece of glass, though the body panel retains its flowing line into the deck. Small body changes on Buick and Oldsmobile carry the 1965 theme; the big Chevrolet will have minor refinements; Corvair and Corvette will continue practically unchanged.

Ford and Mercury. With completely new chassis and bodies for 1965, Ford will only get horizontally split grilles, softer fender lines, and some new roof



GM's air-injection system uses a belt-driven pump to blow air inside the exhaust manifold for fuller combustion—and less air pollution.

lines—overall appearance will be the same. The transmissions will have some minor improvements. Station wagons will have tailgates hinged both side and bottom so they can be used either as a door or as a floor extension.

Mercury will have smaller parking lights in the front fenders, new tail lights, and a new grille. A special two-door hardtop with sloping rear window (like Pontiac's Grand Prix) is in the works, but won't be ready until 1966½.

Roll on, 1966½. Despite Chevrolet's smug confidence in the Corvair and the Corvette, GM has found it necessary to come up with more specific answers to the Mustang. Three names have been suggested for the Chevrolet version: Colt, Panther, and Chevette. The car will be slightly larger than the Mustang and have a choice of sixes and V-8s. Its styling lines will be similar to the Chevy II Super Nova show car.

Pontiac will have another rival for the Mustang, with distinctive styling and a wide range of power options. Mercury's Cougar is also expected for 1966½. It will share many components with the Mustang, but will have a 112-inch wheelbase and an overall length of just under 190 inches.

Ford is preparing to build between 500,000 and a million Mustangs in 1966, and this market segment could easily swell to two million cars. How the new and bigger compacts will catch on with the public is anybody's guess. ■■

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Fast action was called for to protect U. S. citizens in the Dominican Republic. The Navy responded with a ship that can do anything

Our One-Package Landing

By George Fielding Eliot PHOTOS BY BARRETT GALLAGHER

"THE United States Government has been informed by military authorities in the Dominican Republic that American lives are in danger. These authorities are no longer able to guarantee their safety and they have reported that the assistance of military personnel is now needed for that purpose.

"I have ordered the Secretary of Defense to put the necessary American troops ashore in order to give protection to hundreds of Americans who are still in the Dominican Republic and to escort them safely back to this country . . ."

Thus spoke President Johnson to the American people in a nationwide television appearance on April 28.

In Santo Domingo, capital of the Dominican Republic, dissident army officers had seized arms depots, radio stations,

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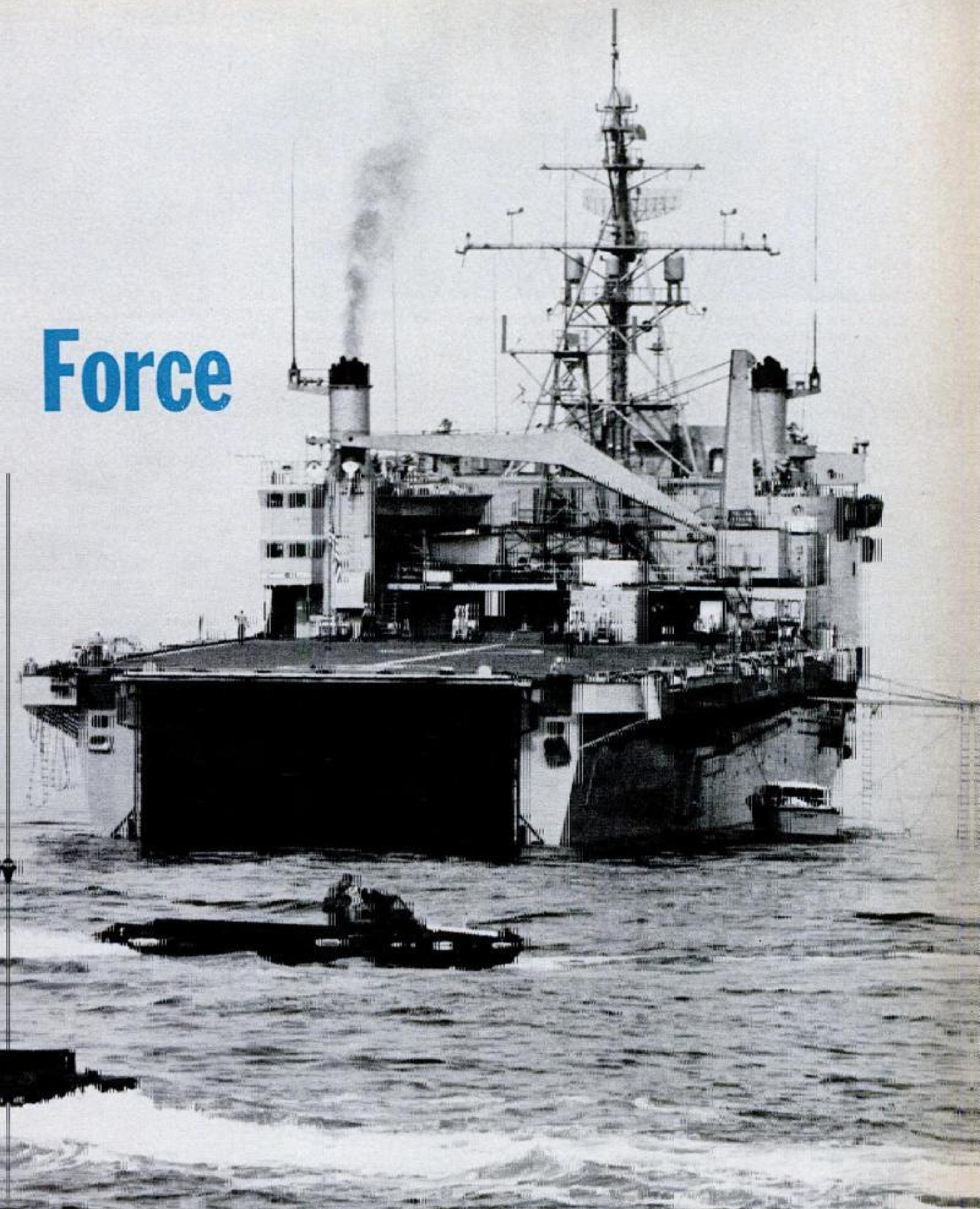

Force

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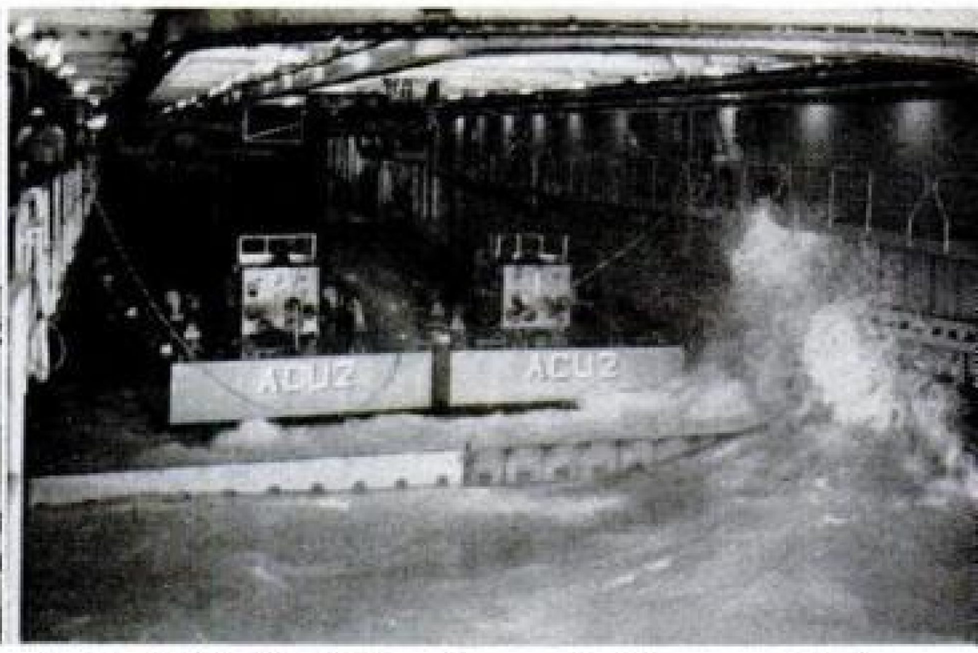
Vehicles and weapons—plus manpower—fill Raleigh's hold

About to enter Raleigh's dock is 180-ton-capacity utility craft, largest the LPD can handle.



As LCM-8s load, barrier controls waves in well, which is eight feet deep at maximum.

and other strategic points. Bands of rebels roamed the streets with machine guns.

At the Embajador Hotel, American tourists and businessmen began to gather. Suddenly a hail of bullets sent those outside the hotel to the pavement, some shielding their children with their bodies. A few crawled under parked cars; others sprinted for the hotel entrance.

Action by the United States was quick and dramatic. To the scene sped three ships of the U.S. Navy, among them the USS Raleigh, the Navy's first amphibious transport dock and one of the most formidable and versatile ships ever built.

In one of the fastest naval operations ever conducted, 1,172 Americans were removed from the island by helicopters from the Raleigh and USS Boxer. A short time later, Marines carried by the ships landed in the Dominican Republic . . .

THIS was the first trial by fire of the USS Raleigh—a new type of ship that carries enough equipment and manpower in her holds to extinguish a brushfire war or play an important role in a larger war.

In Navy jargon, the Raleigh is a Landing Platform Dock, or LPD; in plain English, a one-package landing force and the most flexible instrument of amphibious warfare in the world.

• In her well deck (dock), which can be opened to the sea, she can carry up to nine landing craft—enough to put all her Marines ashore at one time if desired.

• Beneath her decks she can berth and feed 930 fighting men and stow all their weapons and gear—and still have room for a ship's company of 462.

• In her cargo spaces she has room for 200 assorted vehicles: tanks, amtracs (amphibious tractors), artillery, trucks, jeeps, engineer vehicles—you name it—plus a balanced load of rations, fuel, and other military supplies. All ve-

Marines and vehicles, launched by LPD, hit the

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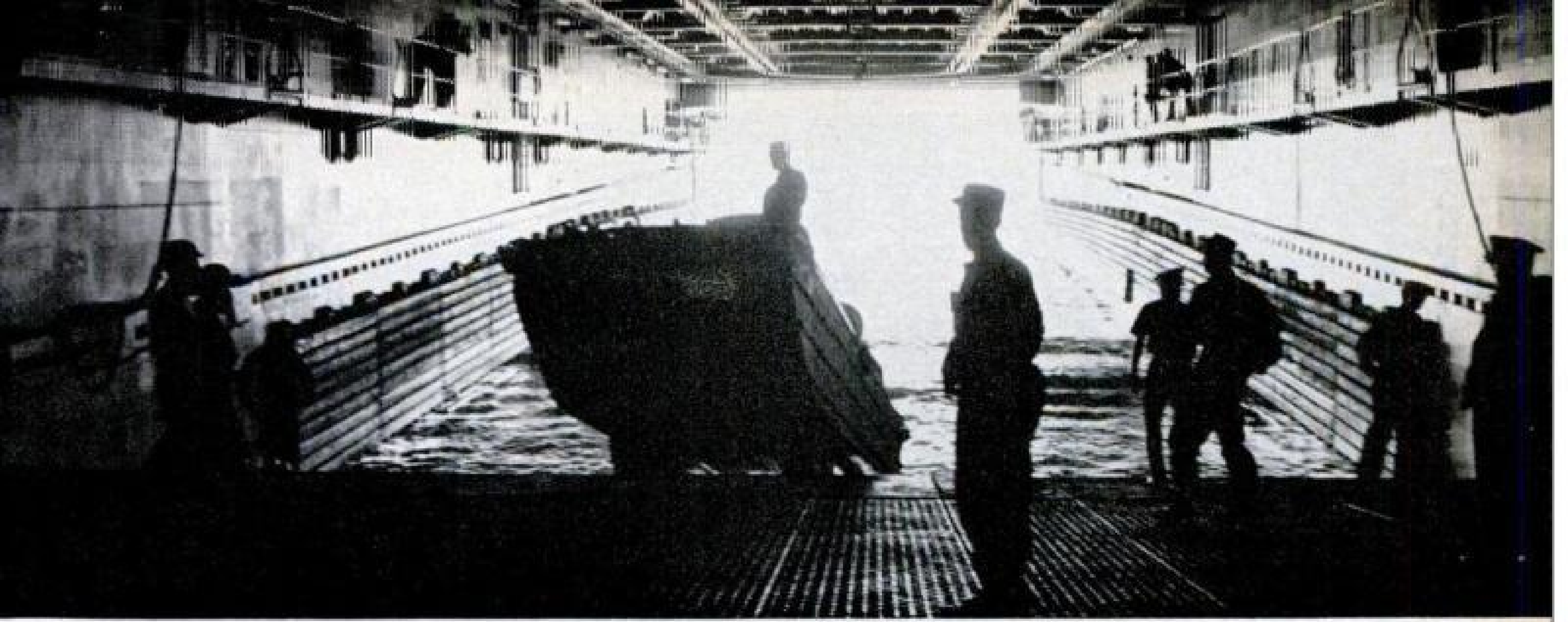

Disembarking amphibious tractor, just one of 200 assorted vehicles Raleigh carries, gets set to slip from deck into watery well. Marines and equipment can be unloaded in record time.

hicles are kept loaded and ready to go.

• On her helicopter deck, above the well deck, she can carry up to six helicopters—enough to fly in a strong advance party to support a landing.

Four ships in one. Perhaps the most spectacular aspect of the Raleigh is that it can take the place of four types of amphibious ships that formerly had to work together in combination. One LPD like the Raleigh can replace an assault transport (APA) for carrying troops; an assault cargo ship (AKA) loaded with rations, supplies, and equipment; a tank landing ship (LST) with tanks and other vehicles; and dock landing ships (LSD) for landing troops.

This means that the fighting men, heart of an amphibious landing force, are never separated from their weapons, their vehicles, or their supplies.

The tremendous advantages of such a striking force are easy to appreciate when

[continued on page 164]

beach. Raleigh handles four LCM-8s, or nine smaller LCM-6s—enough to carry all her troops.

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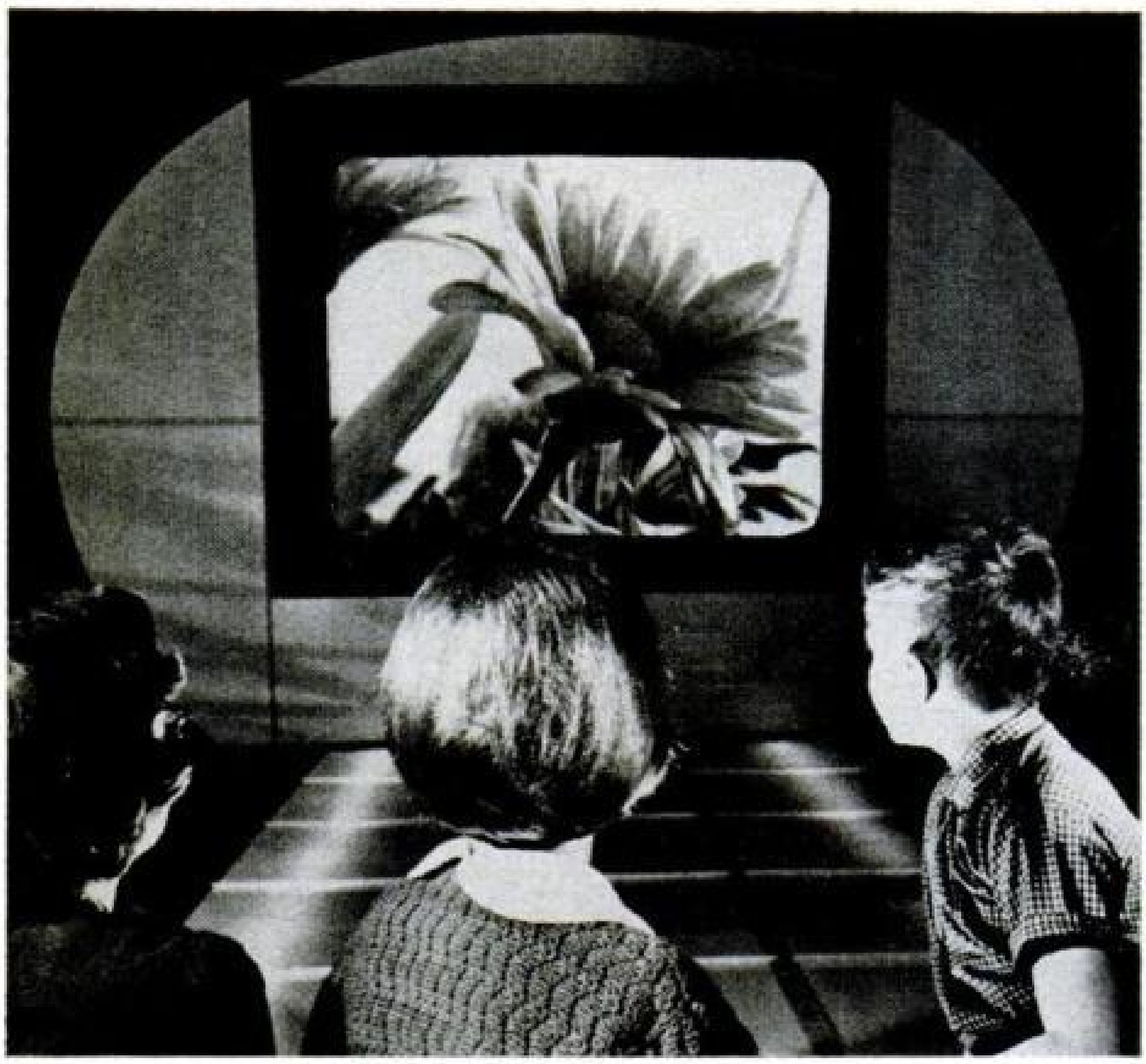


Viewers in Chicago Science Hall's movie theater smell the odor of flowers in a field in addition to seeing them on the screen.

Wet dog's musty odor follows him out of water.

Fragrance of lavender accompanies grandmother.

Movie You Feel and Smell as Well as See

In a theater at Borg-Warner's Science Hall in Chicago, you can feel and smell a movie. The theater is an environment chamber that adds temperature, humidity, and odor to the sound and color of the picture. You feel the heat of summer or chill

Pass holed-through under Alps

The dramatic photo at left, with torchlight shining off its jagged sides, was taken just after the final blast that shattered through the walls of the San Bernardino Tunnel in the Alps. Italian workmen are shown breaking away loose rock still blocking the opening.

When completed in two years, the tunnel will connect with southern Switzerland and will be the second big automobile underpass through the Alps.

Urheberrechtlich geschütztes Material

Pressure pots contain extracts of odors that are released through air-conditioning system.

Electronic memory drum is programed to match action on film, switch on appropriate effects.

of winter as temperature and humidity change to match action on the screen. During an 11-minute movie you smell the odor of a musty cave that was man's first shelter, a field of flowers, a wet dog, a girl's perfume. In a behind-the-scenes room is an electronic memory drum programed to mate with notches on the film that trip switches on the projector. In another room is an air-conditioning system for rapid changes in temperature, humidity, and odors. A third room has pressure pots of extracts of natural and synthetic odors recharged with compressed air after each injection.

Grenades launched at 200 per minute

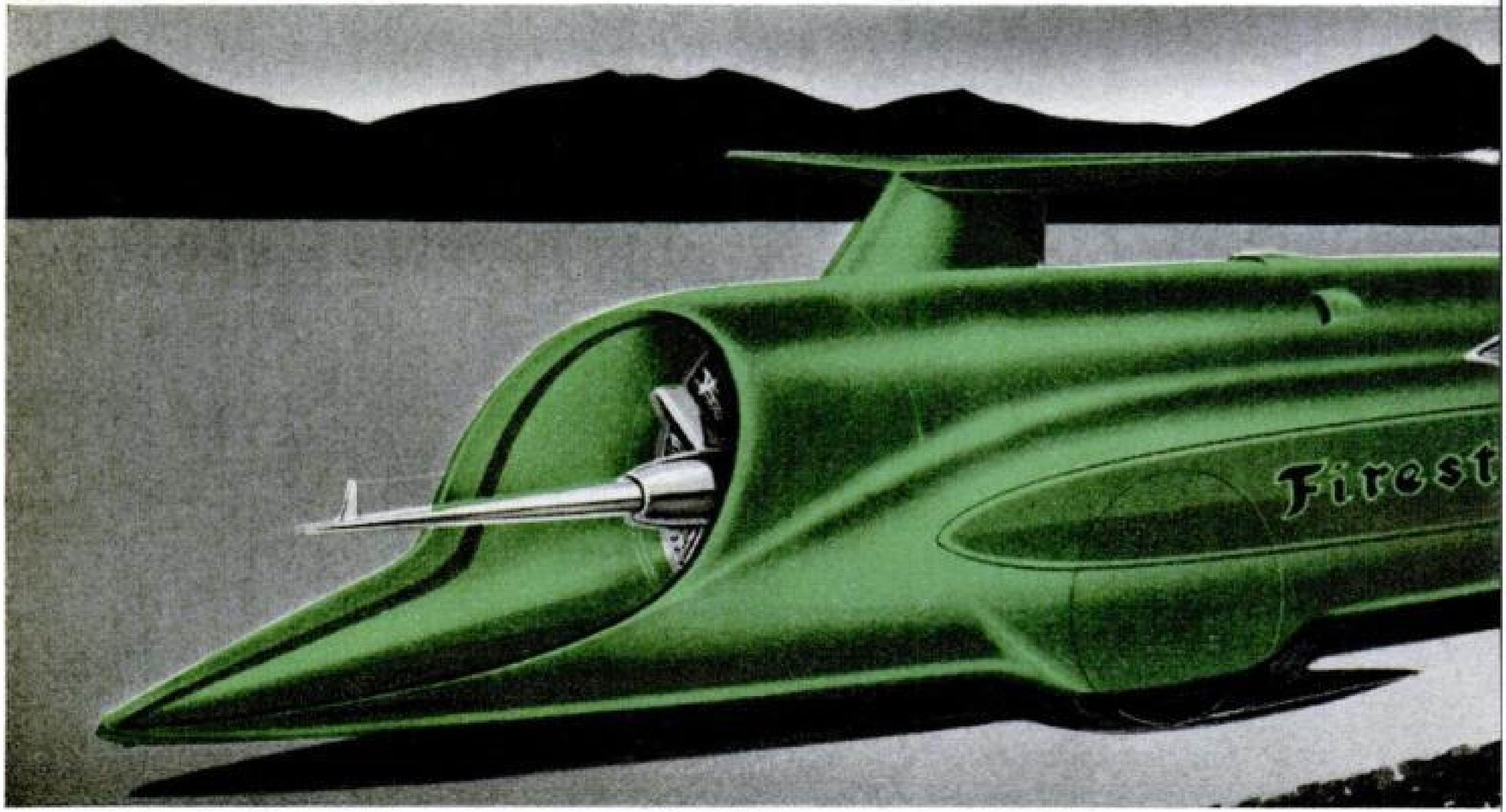
The deadly stinger shown at right mounted on the nose of a UH-1B Iroquois helicopter hurls 200 grenades per minute at ground targets nearly a mile away.

Built by GE for the Army, the new rapid-fire weapon is designed to deliver 40-mm grenades in anti-guerrilla warfare or in effective air support of infantry movement. It can be aimed and operated either by the helicopter pilot or by a gunner at his side.

Urheberrechtlich geschütztes Material

EXCLUSIVE! Art Arfons' own story:

How I'll Drive Faster



One of the leading designs for a four-wheeled supersonic vehicle being considered by

A man who has the master's touch with machinery prepares a jet-driven car to assail the unknown

(as told to Devon Francis)

LAST October 27 I had the privilege—and let's face it, the good luck—of becoming the world's fastest man on wheels. I drove 536.71 miles an hour. It was a wild ride.

On the second anniversary of that event (in the fall of 1966) I am determined to become the first man to drive faster than sound. That will be something in excess of 700 m.p.h.

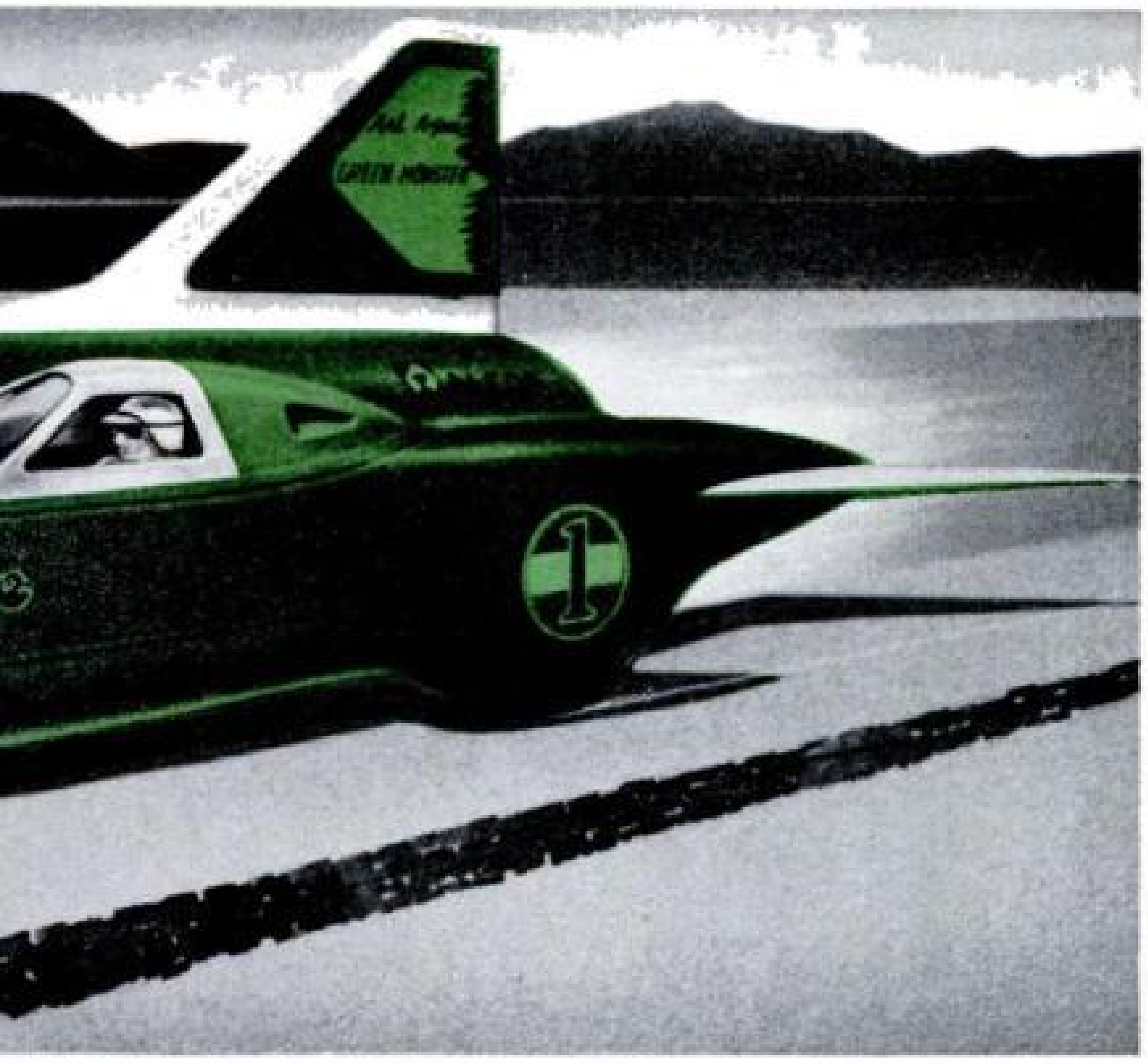
Arfons (right) talks speed with Devon Francis.

The world's fastest man on wheels is ruggedly handsome, an inch short of six feet tall, and weighs 195 pounds. Of Greek extraction, he is a sort of mechanic's mechanic—he seems to have been born with a knowledge of nuts and bolts.

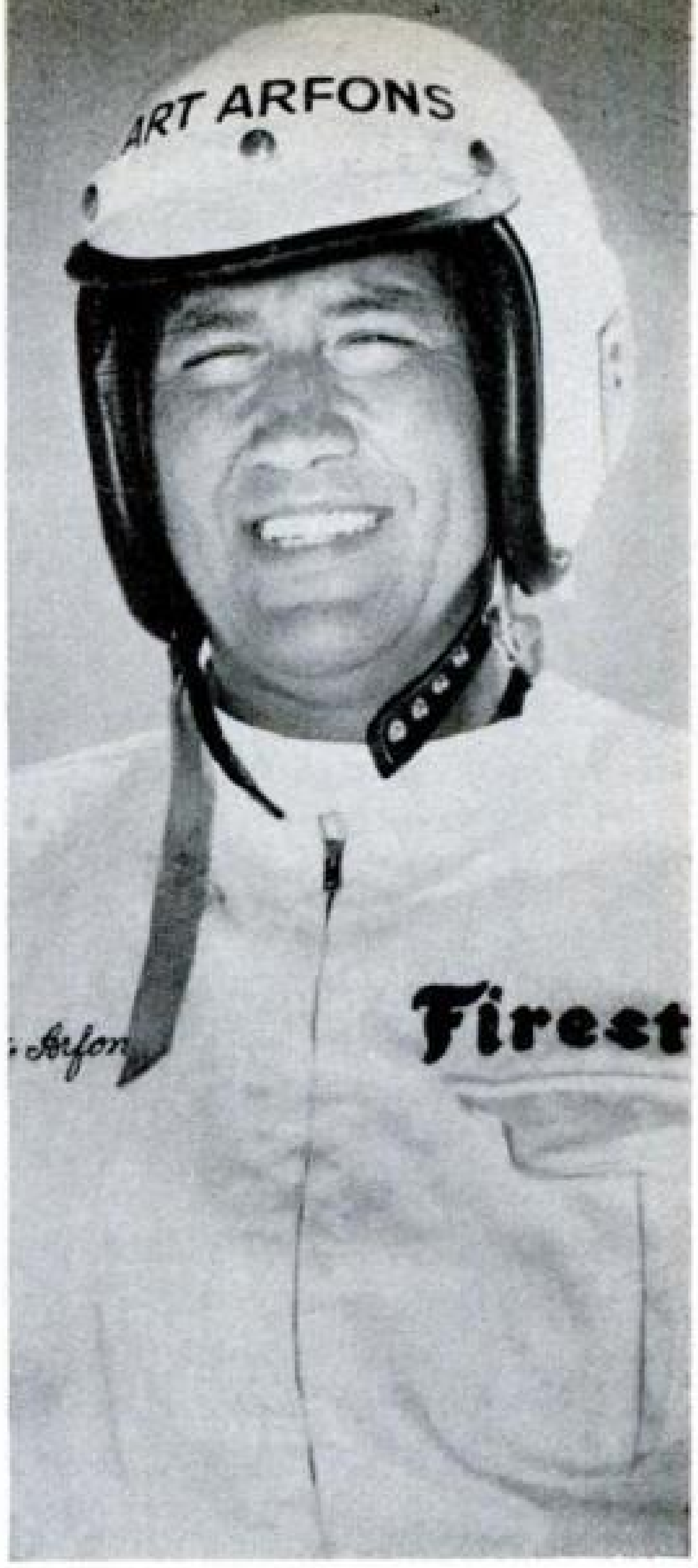
In World War II, while serving as a mechanic on a landing craft in the Pacific, Art Arfons rigged up a motorized, remote-controlled ramp in place of the customary hand-crank ramp, to reduce casualties from enemy fire during assault landings. His boat was in the first wave at the invasion of Okinawa.

Urheberrechtlich geschütztes Materia

Than Sound



Arfons is this one by stylist-engineer Alex Tremulis.



"Like quarreling with a woman."

Before then, this fall, I want to try nudging the speed of sound at, say, 650 m.p.h., to explore some of the problems in supersonics.

Why do I think I can drive faster than sound? How do I plan to do it? Pull up a chair:

Anyone who followed the competition at the Bonneville Salt Flats in Utah last fall knows that two other speed merchants and I had quite a game of hopscotch going for a period of weeks.

Until the fall of 1963, England's John Cobb, with a record of 394 m.p.h. on those same salt flats, had been the world's fastest man on wheels for 16 years. Then Craig Breedlove of California topped that mark with 407 m.p.h. There was a lot of mumbo jumbo about "official" rules—Breedlove had only three wheels,

CONTINUED

Deciding that hand-rocking the cradle of his firstborn child was a waste of energy, he adapted a windshield-wiper motor to the job, using a transformer to vary its speed and a timer to shut it off.

Without ever having seen an automatic automobile transmission, he years ago took an ailing one apart, fixed it, and reassembled it. No problem.

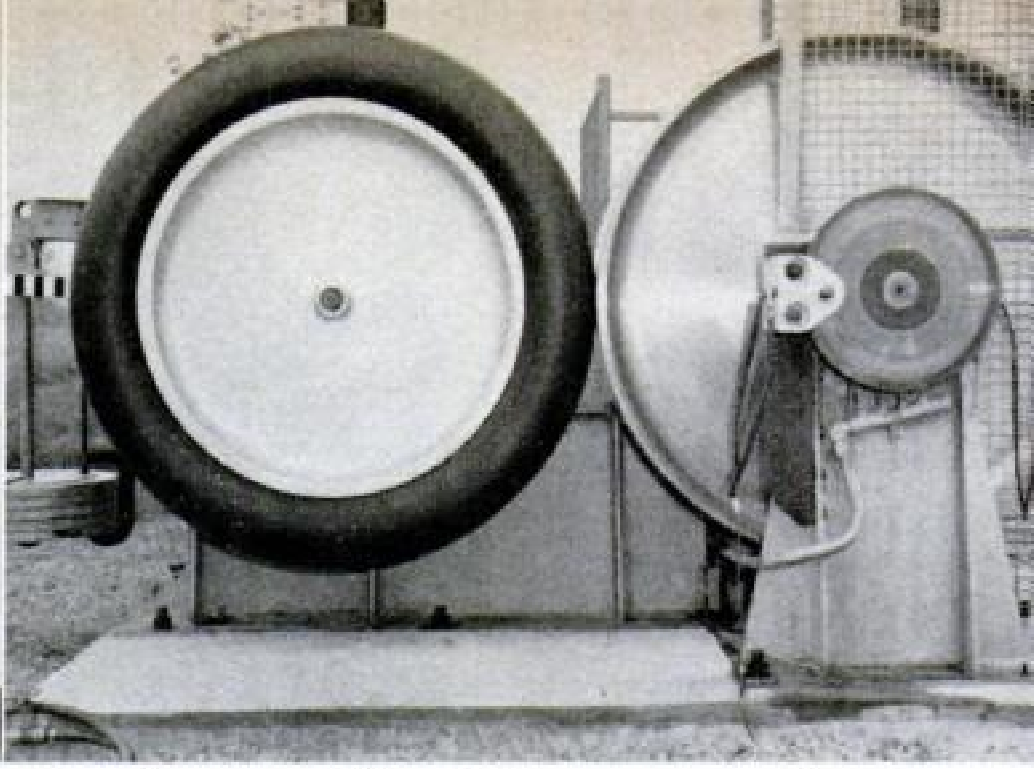
So it was nothing for him to design and build an automatic, hydraulically operated canard "wing" to make the front wheels of his record-shattering Green Monster stay on the ground instead of taking off like a plane. It was nothing for him to repair the compressor of a surplus Air Force gas-turbine engine without ever having seen the insides of a jet, and this particular one was a highly sophisticated bit of machinery.

While he was being interviewed during the preparation of this article, Arfons, now 39, modestly asked PS's Devon Francis, "Don't you think it sounds like boasting for me to say, 'How I'll Drive Faster Than Sound'?"

Not for Art Arfons.

Urheberrechtlich geschütztes Material

Tire stiffness requires split rims (18 inches in diameter for present Monsters, 22 for future ones), held in place by 20 cap screws.



Test rig powered by PT-boat engine will spin 14-ply, bald supersonic tires 800 m.p.h.—centrifugal force would throw off any tread.

not four, and his power came from jet reaction, not through driving wheels—but that didn't alter the fact that he had hung up a new land speed record.

Blowtorches on wheels. In 1964, three of us with vehicles all driven by gas-turbine engines—and all by jet reaction—went out to better that figure. Let's concede that these racers were not "automobiles" in the accepted sense of the word. They were giant blowtorches, like jet planes. But they ran on wheels. They didn't fly.

One of these men out to beat the record was Breedlove himself. The others were Tom Green and I. Green comes from Chicago.

The speed figure went up and up on the salt flats, each of us taking turns. Breedlove finally not only smashed every record in the book with an incredible 526 m.p.h. but his racer as well in the process.

I managed to top that with 536, only 65 miles an hour short of the cruising speed of the fastest of today's commercial jetliners.

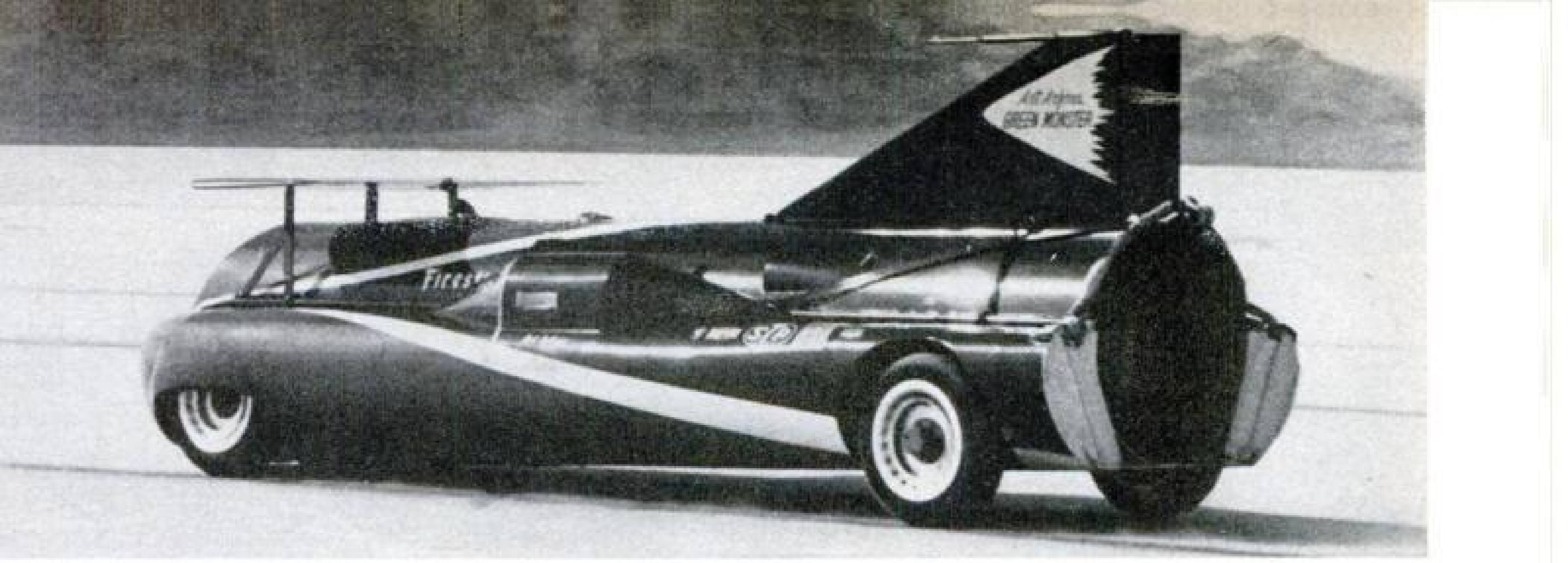
While this was as hairy an experience as I had ever encountered in years of drag racing, my mount, the Green Monster, gave me no trouble. That's the main reason I believe I can build a racer that I can drive faster than sound. Let me specify:

• I've got the power. My basic engine, a General Electric J-79 that drives Air Force fighters at twice the speed of sound, produces 10,000 horsepower at 375 m.p.h. (using the formula that in a gas turbine one pound of thrust equals one horsepower at that speed). It has four stages of afterburner for even more power. I used only one stage of afterburner last October.

• I know how to keep the front wheels on the ground. I used a small hinged wing—a true inverted airfoil—of my own design and construction to keep the proper pressure on those wheels. If the Monster began getting anxious to get airborne, a hydraulic cylinder between the chassis and the front axle sensed it, and instantly transmitted an order to another hydraulic cylinder, between the trailing edge of my wing and the top of the engine cowling, to depress. The inverted airfoil, with the "lift" on its lower side, naturally tended to put pressure on the front wheels. When it was tilted downward, of course, it added even more pressure.

• I've got the control. The best proof of that is that I blew a tire at what may well have been in excess of 600 m.p.h. The Firestone engineers had warned me that while my tires probably would take 600, exceeding 550 would stretch my luck. I was too tempted. Nonetheless, the racer ran straight and true on that right rear rim until I got it stopped. My "fin" (the vertical stabilizer), my wing, and my steering mechanism (incidentally, adapt-

Urheberrechtlich geschütztes Material



Record-holding Green Monster chewed up right rear tire on Salt Flats last fall due to load imposed on it by tremendous engine torque. Tires showed only five-pound pressure increase after 536-m.p.h. run. Timken wheel bearings will be liquid-lubed; grease would melt.

ed from a 1955 Packard) took care of me.

The problems. There are, of course, problems to be solved before I undertake a supersonic run. Ed Snyder, my fine assistant designer, and I recognize them.

The first is tires. A wheel and a tire are just a huge centrifuge. A centrifuge can destroy itself if it whirls fast enough.

The smaller the centrifuge, the less the problem. A small one, a simple disk turbine like those inside the engine of Chrysler's gas-turbine car, for instance, can turn 45,000 r.p.m. My wheels and tires will be far larger. With a diameter of about 30 inches, tubeless tire included, each will be a little bit bigger than a standard 14-inch passenger-car wheel fitted with a 7.50 tire.

But a tire is a doughnut and flexible, not a simple disk, and as it gains speed, the stresses on it will shoot up, especially under the load that the car imposes on it. Firestone can prespin our wheels and tires faster than they can safely go on the salt flats.

I am told that even at transonic speed, early in the 700-m.p.h. range, each wheel on my racer, turning about 7,000 r.p.m., will exert 893,000 pounds of centrifugal force. That's equal to the weight of seven or eight fully loaded box cars.

The tire problem is being solved. There is not a doubt in my mind that Firestone will come up with tires that can be accelerated from a standing start to 800 m.p.h. in less than a minute—on a test rig. They surely will carry the Green Monster into supersonic speed.

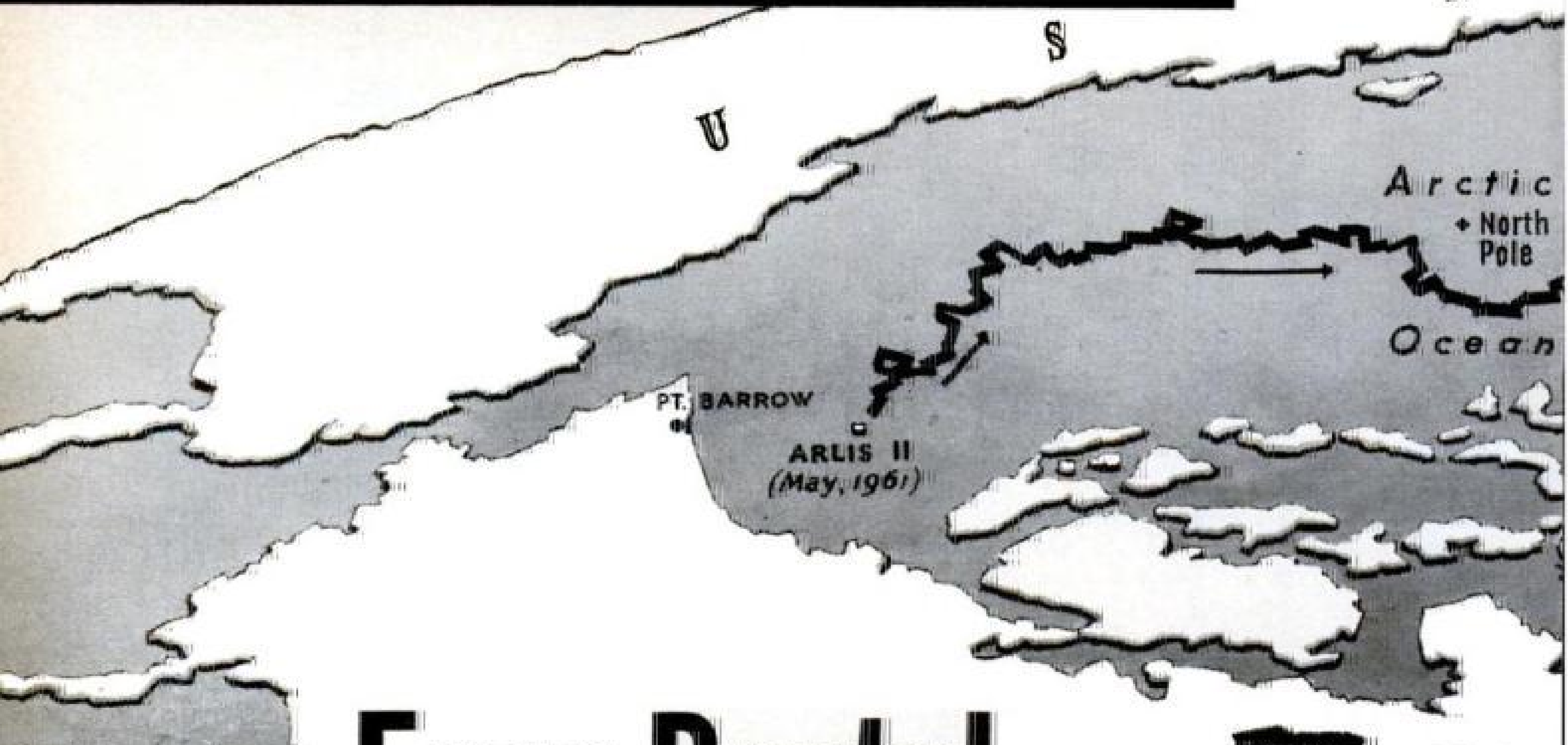
Licking the shock wave. The second and stickiest problem is the configuration of my vehicle. At transonic and supersonic speeds a pressure, or shock, wave of air builds up on any solid object, even a bullet. This has become

[*Continued on page168*]

Other designs have put stabilizing wing high and low

Arfons has considered two other body designs in the last few months, both featuring big center cone for engine to reduce an airflow problem when power is cut. Low stabilizing wings in design at right would be useless due to turbulent air. In design at left, wing atop engine is better. Enclosed wheels will keep pressure, or shock, wave off tires.

Urheberrechtlich geschütztes Material



Four Brutal Years on a Floating Ice Island

By Herbert Shuldiner

PS reporter Herb Shuldiner visited ice island last spring.

Our reporter faces Arctic blasts to visit the team of rugged men who drifted across the top of the world on a mile-long ice cube

ARLIS II—which is breaking into small pieces and disappearing as you read this—was one of the weirdest "ships" the U.S. Navy ever sailed. It was a floating ice island that once measured two miles long, a mile and a half wide, and averaged 70 feet in thickness. Scientists

Here's how Arlis II looked two years ago. By last spring, snow had all but buried the huts.

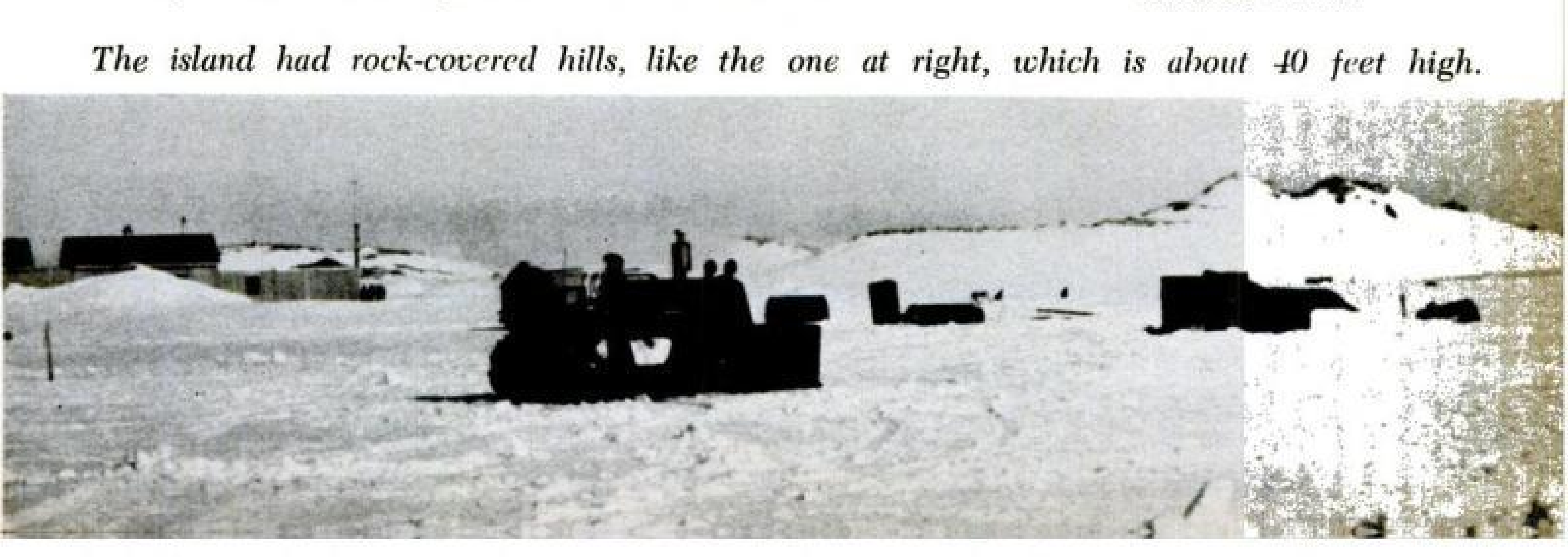
found it drifting in the Arctic Ocean in 1961, about 130 miles north of Alaska, and turned it into a unique research vessel.

The island was occupied by researchers for four brutal years as it drifted across the top of the world. Then, just before the island began to disintegrate, the last 20 men were evacuated by the Navy icebreaker Edisto off the coast of Greenland. In its odyssey, Arlis II meandered about 7,500 miles—once coming within 86 miles of the North Pole.

I flew to this jumbo ice cube shortly before it was abandoned to find out, first hand, how these men survived, what they had been doing, and what it all meant. CONTINUED

Max Brewer (right) talks to station chief Clarence Nolan.

The island had rock-covered hills, like the one at right, which is about 40 feet high.



Arctic scientists gave our nuclear subs "eyes" to cruise under

Max C. Brewer, director of the University of Alaska's Arctic Research Laboratory, who supervised the program for the U.S. Office of Naval Research, told me he believes the island broke off a glacier on Ellesmere Island about 100 years before he found it while on a flight over the ice cap. He named it Arlis II (for Arctic Research Laboratory Ice Station II).

Marine biologist Rey Stendel, University of Southern California, examines samples taken from ocean bottom for marine life. Several new species were discovered by Arlis II scientists.

Arlis II scientists made many contributions both to our knowledge of the Arctic and to our nuclear submarine operations under the polar ice cap, though some of the details are still top secret. Among the more important contributions:

- A giant underwater mountain range, called the Lomonosov Ridge, was located. It stretches over 1,000 miles and splits the Arctic Ocean into two basins.
- The coldest temperatures ever on Arctic ice—down to 72 below—were recorded. Temperature data give meteorologists new insights into how our weather originates.
- For the first time, the heat flow from the center of the earth in the Arctic was measured. The surprising conclusion: It's about the same over most of the globe.
- The first complete maps of Arctic currents were made.

In addition, Arlis II scientists mapped much of the bottom of the Arctic Ocean, an invaluable aid for submarines. They had to go down over 12,000 feet to find the bottom at some points. By dropping Nansen bottles (sample-collecting devices) through holes in the ice, researchers collected and analyzed specimens from the ocean depths and discovered several new species of marine life.

Under the snow. They did this work on the most barren, desolate-looking terrain I have ever seen. Four years of accumulated snow had all but buried the huts that housed the scientists. Though the huts were originally built above the surface, I had to climb down into them.

Supply plane comes in for landing on ice island's snowy runway. Planes could land only when snow was frozen. But more than 400 flights were made to Arlis II as it drifted.

Arlis II scientist enters hut by climbing down into it. Blanket of snow, which almost covers entire 12-by-16 foot hut, helped keep it warm. The huts were erected over insulated pads. Prefabricated panels of insulated plywood were used. They resisted winds of up to 70 m.p.h. for four years. Generators provided constant electricity for the huts.

Arlis II was a vast plain broken here and there by barely visible hut rooftops, antennas, and some small hills (the highest was 43 feet tall). The hills were covered with rocks, apparently debris that the glacier had picked up as it slid into the sea decades ago. The ice island rides low in the water and is only six feet higher than the ice around it.

When I landed, it was floating about 4,800 feet above the ocean bottom and was moving at about 30 miles a day. But I had no feeling of movement or of the impending destruction by the sea. The rest of the ice pack moves right along with the ice island.

The camp was divided into two parts. The main section consisted of the mess-hall complex, surrounded by sleeping huts. The buildings were made of prefabricated insulated plywood.

A half-mile away, near the edge of the island where the ice is thinner, there were several research huts. Two of these had hydrographic holes (openings in the ice) through which the scientists could drop their devices into the ocean.

All the huts were warmed by ordinary fuel-oil stoves. They were warm enough for you to walk about in shirt sleeves. But much work had to be done outdoors in bitter weather, where even the warmest parkas couldn't keep the shivering men comfortable.

I asked William T. McComas, a member of a U. S. Navy Hydrographic Office team tracking the drift of the surrounding sea ice, what effect this fierce weather had on him. "Everything takes five times as long to do," he replied. "The smallest chore can turn out to be a marathon."

Another member of the team, Robert D. Ketchum, agreed with that, but added that walking out on the sea

Dr. Kou Kusonoki of the University of Hokkaido, Japan, holds Nansen bottle used to collect samples from ocean depths for analysis.

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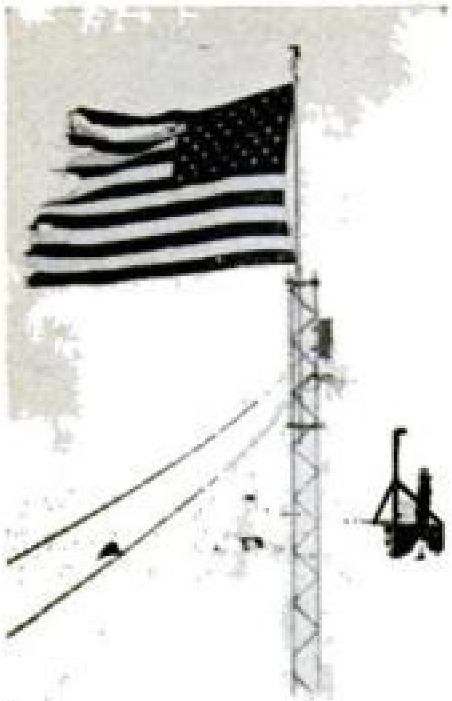
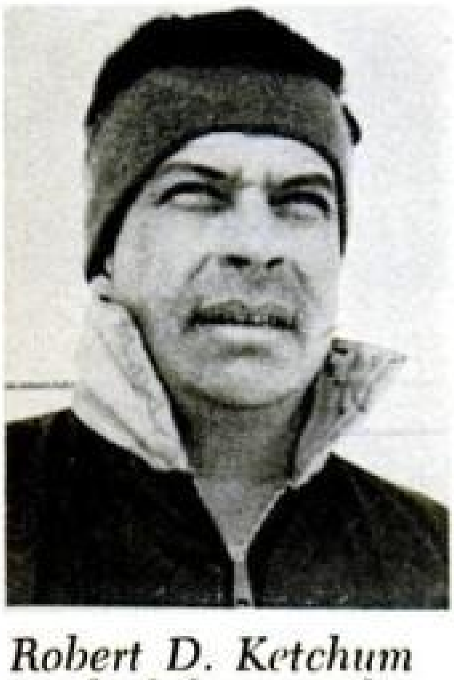
Urheberrechtlich geschütztes Material



Flag flying over Arlis II was torn by severe blizzard that hit the island as it drifted in its final weeks off the coast of Greenland.

Cook Carl Johnston stirs one of his pots. He spent 3½ years on Arlis II.



Robert D. Ketchum tracked down and killed a polar bear on the island.

ice, as he and McComas frequently had to do, was more dangerous to life and limb than the subzero cold.

"Once I stepped into a crack, but I got my foot out before it closed up again," Ketchum told me. "It closes with terrific pressure and sounds like slow-motion thunder as it claps together."

A furry visitor. Another danger was the occasional roving polar bear in search of food. Most of the bears could be scared off with shouts or shots over their heads. But one refused to be discouraged.

Ketchum relates that he was asleep one night when a bunkmate woke him with a cry. "I didn't believe him when he said there was a bear at the window, but then I saw the eyes," Ketchum said. "I picked up a revolver and raced outside to warn the others.

"It was snowing and the wind was really blowing when I caught up with the bear and shot it in the backside."

The animal reared up—"he looked 10 feet tall," Ketchum said. (He was actually seven feet.)

Frank Akpik, an Eskimo worker, came along in a weasel—a snow vehicle—and Ketchum, who grabbed a rifle from another man, jumped aboard to give chase. They caught up with the bear, who turned and started back toward them. "We were standing knee-deep in snow and couldn't run away from him," Ketchum said. "I fired again and hit him in the chest. That got him."

During the summer, when planes couldn't land on the softened runway, everything had to be paradropped. "We tried to supply anything within reason," Max Brewer told me. But one man's request for a female secretary, 18 or older and willing to put up with an old man, was regretfully turned down. "The government supplied everything but women and liquor," Brewer noted.

Another man's request for a sun lamp "so I can melt the island and get off" was filled. "He never did succeed in melting the island," Brewer said, "but he did enjoy a lot of sunbaths."

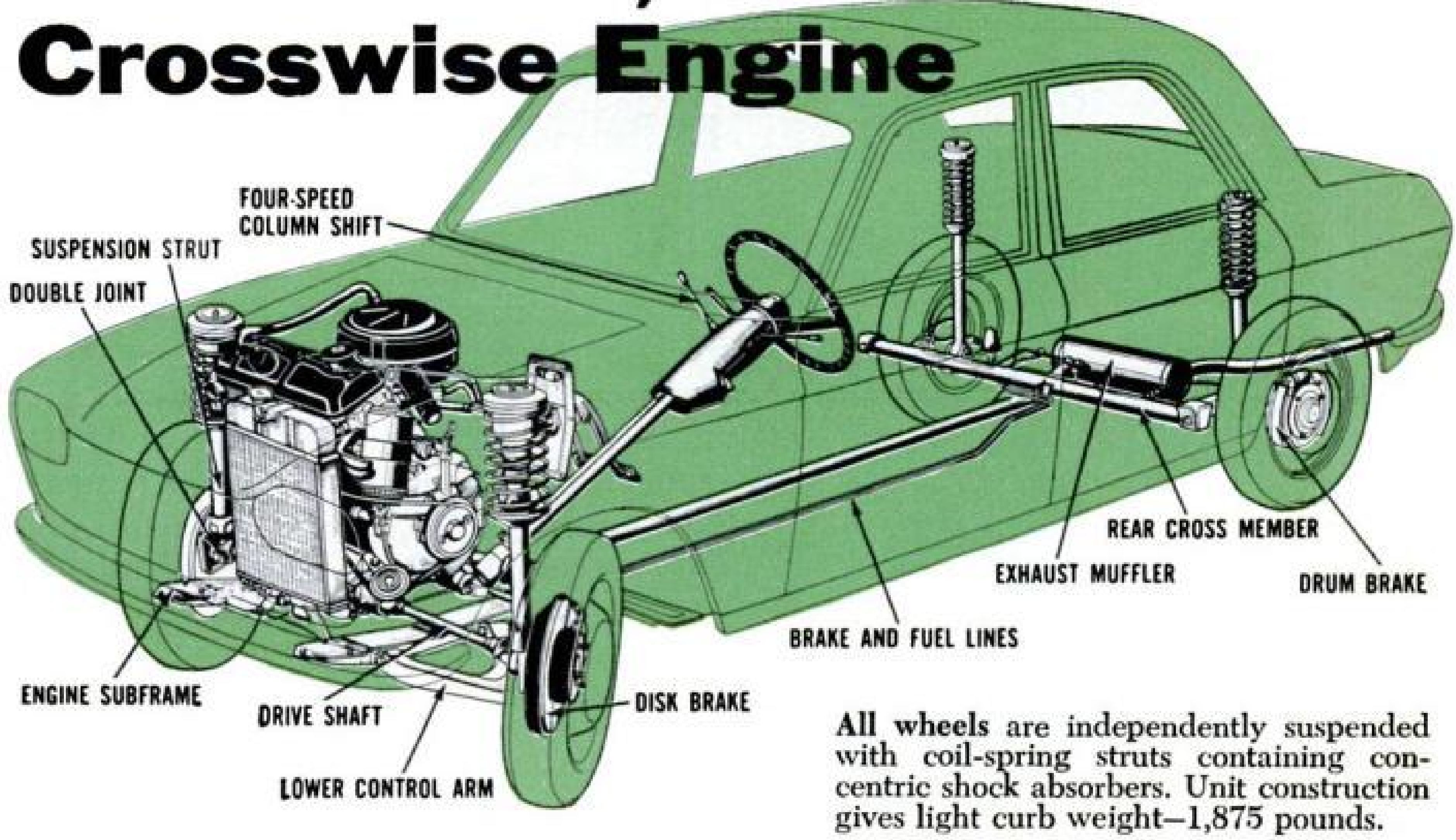
The biggest morale boosters were food and mail. The man responsible for chow was Carl Johnston, a 34-year-old baker from Kearney, Neb. He spent periods totaling 3½ years on Arlis, longer than anyone else. Although Johnston denies that he attempted anything fancy, his menus featured thick, 20-ounce steaks and prime roasts. The men ate an average of three pounds of meat daily and excessive weight was a frequent problem.

Despite plenty of work and good food, the men found it the toughest life imaginable. The planes brought in everything but what they missed most—women.

Why did they put up with the hardships and the loneliness? There was no agreement. Even scientists who had put in several tours couldn't say. Ketchum—who had been on Arlis II four times—said, "Most of us swore we wouldn't come back. But we did." ■■

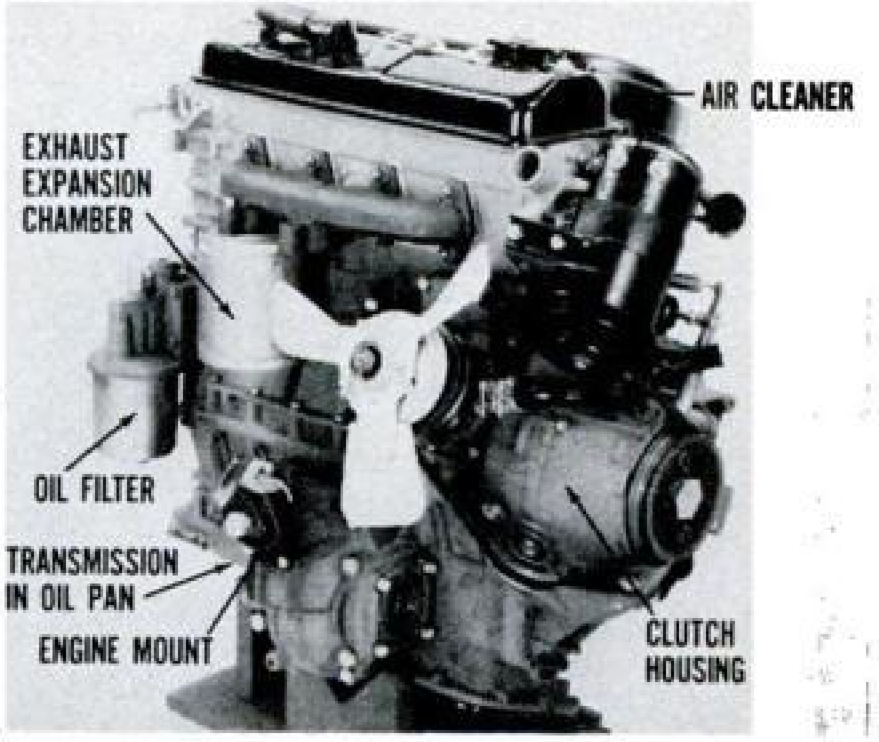
Urheberrechtlich geschütztes Material

New Peugeot Has Front Drive, Crosswise Engine



All wheels are independently suspended with coil-spring struts containing concentric shock absorbers. Unit construction gives light curb weight—1,875 pounds.

PEUGEOT turns to front-wheel drive with its new 204, the first new Peugeot in five years. The four-cylinder 69-cu.-in. aluminum engine has a single overhead camshaft and is placed crosswise in the chassis. The four-speed transmission is housed inside the oil pan. Power output is 58 hp. at 5,800 r.p.m. Combustion chambers are hemispherical, with inlet and exhaust ports on opposite sides of the head. The differential is located at the front of the oil pan, and the engine leans forward to lower the hood line. The drive shafts have double universal joints at the outer ends to allow extremely large steering angles (constant-velocity joints have limited angularity). The 156-inch four-door sedan was styled by Pininfarina, and is distinguished by a long hood, short deck, and rectangular headlights. There are no plans to market the car in the U.S. at the moment.



Thermostatically controlled fan is driven by twisted belt (à la Corvair). Single OHC is chain-driven. Crankshaft runs in five bearings.

Little Peugeot is 13 feet long, has rectangular headlights, sloping hood. Instruments include a voltmeter to show battery charge.

Urheberrechtlich geschütztes Material

How a PS reporter got a set of stomach "portraits" with an amazing new miniature camera

The Day

By Robert Gannon

A FEW months ago a 49-year-old New York City clerk brought his daughter into the examining room of Dr. Jerome Weiss, Adjunct Professor of Gastroenterology (study of the stomach), at Manhattan's Polyclinic Medical School. While Dr. Weiss checked the girl, her father mentioned that he had eaten no breakfast. The remark probably saved the man's life.

Dr. Weiss was looking for a subject on whom to try out an improved tiny camera designed to be dropped down throats to photograph the inside of stomachs. He wanted pictures of a normal stomach to use as a comparison yardstick, and the only requirement was that the subject not have eaten for four hours. The little girl's father was talked into being a guinea pig.

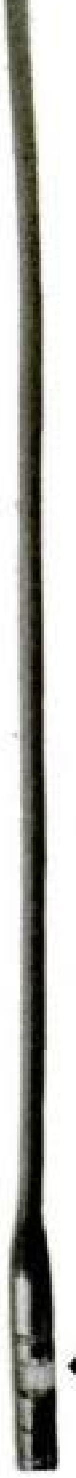
As Dr. Weiss examined the prints later, he detected a small gray mass half hidden by a fold of the stomach wall. It made him suspicious enough to recommend exploratory surgery. Reluctantly, the patient agreed.

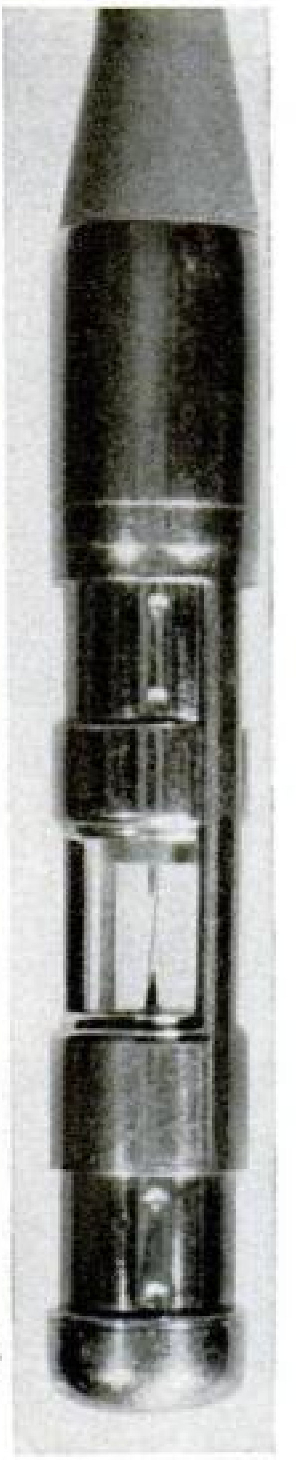
"It's fortunate he did," says Dr. Weiss. "We found a malignant tumor the size of a Ping-pong ball." The cancer was cut out.

Wall-to-wall photos. Since then, more than 1,000 patients have had their stomachs photographed wall-to-wall and in living color by Dr. Weiss and other researchers. So far, he says the lives of at least three patients have been saved, and probably a great many more.

Popular Science asked Dr. Weiss to photograph my stomach just so I could report on what it was like.

Well, the experience was strange. Dr. Weiss poured me a shot of Pontocaine (a throat deadener that acts like Novocain) and asked me to lie on my right





Stomach camera (right) is about the size of a chubby cigarette and has a transparent midsection. Ends have eight pinhole-size plastic lenses—each 1/250 inch in diameter, with focal lengths just under an inch. Some lenses are set at an angle so views overlap slightly, thus covering the entire stomach area. The transparent center has a one-time-only flash foil. The camera is pushed down your throat on the end of the ⅜-inch vinyl-covered tube (left) containing wires, shutter release, and air line. A complete outfit, including power unit, tubing, and two camera heads, costs approximately $900.

Urheberrechtlich geschütztes Material

I Swallowed a Camera

Dr. Jerome Weiss guides camera down PS writer Robert Gannon's desensitized throat.

side to allow the fluid in my stomach to drain out.

"I'll pass the camera down your throat until it hangs in your stomach," Dr. Weiss said. "Then I'll pump up your stomach with this bulb. That's to push the sides out far enough for the lining

[Continued on page 180]

Photos like the normal section at right are produced by stomach camera. A 50,000-candlepower cold-light flash reveals every crevice in the walls of the stomach.

Urheberrechtlich geschütztes Material

Gemini orbit-changing opens door to—

A Rendezvous

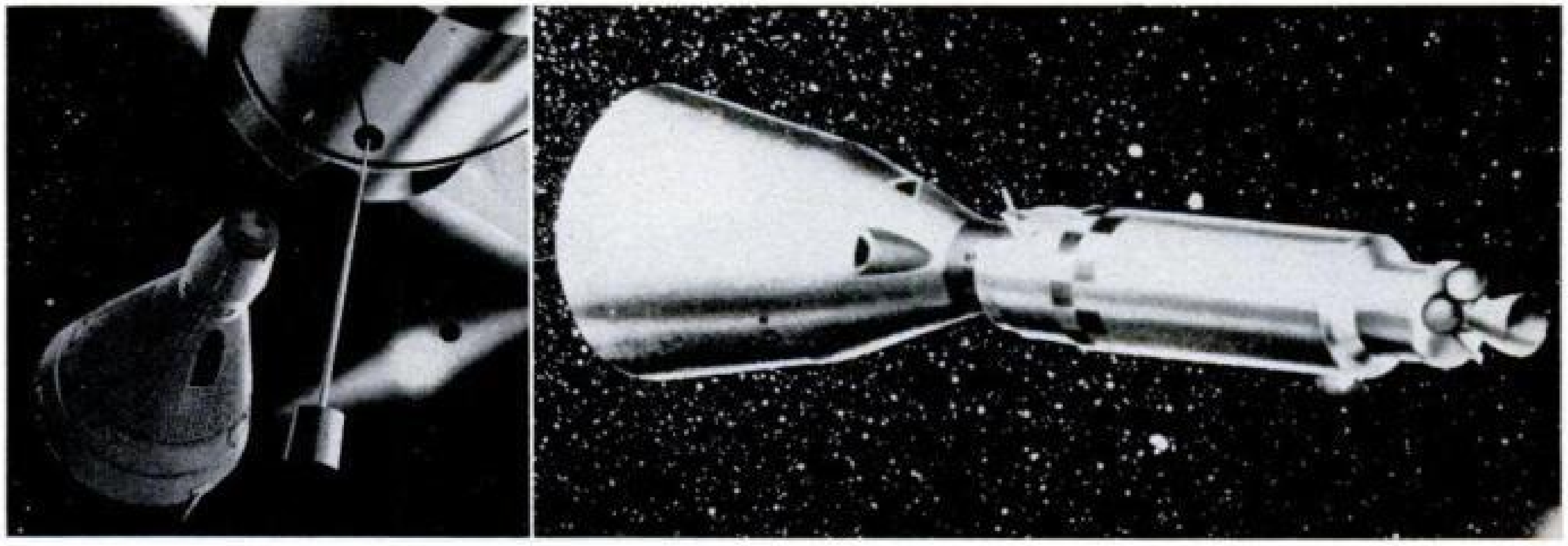
Guiding craft to a meeting, soon to be tried, will be key maneuver in going to moon and to space stations

Dr. von Braun takes pilot's position (far side) in Gemini simulator used for trials at NASA's Manned Spacecraft Center, Houston, Tex.

in Space

By Dr. Wernher von Braun

Director of NASA's George C. Marshall Space Flight Center, Huntsville, Ala.



Gemini spacecraft will maneuver to approach Agena target vehicle, then latch on to it.

WHEN a Gemini spacecraft's pilot altered its orbit, in the space flight last March of Maj. Virgil I. Grissom and Lt. Cmdr. John W. Young, the feat was hailed as historic. For the first time, a manned spacecraft was maneuvered from one orbit to another. In this case, there were three successive changes, both in the height and in the inclination of the orbit.

The feat was important because it was the first successful trial of a system designed to maneuver a manned spacecraft for rendezvous and docking. And the capability of two space vehicles to meet, and latch on to each other, is a key requirement for many coming spaceflight objectives.

For example, Apollo's Lunar Excursion Module, bearing two astronauts returning from the lunar surface, must rendezvous and then dock with the Service and Command Module. The latter, with its lonely "shipkeeper," will have been orbiting around the moon during the LEM's descent to the lunar surface and its re-ascent. Rendezvous is the only way to get all three Apollo astronauts back to earth.

Space stations, repair missions, space refueling, and satellite inspection will all require a well-developed technique of orbital rendezvous and docking.

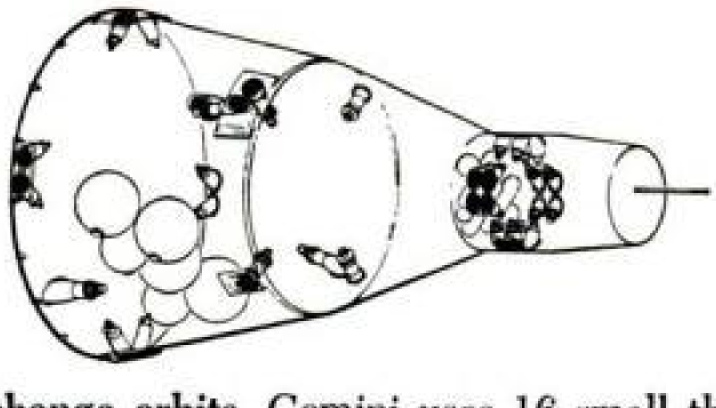
Rendezvous. Our two-man Gemini spacecraft, designed specifically with rendezvous and docking in mind, will soon attempt just that. Flight GTA-6—the fourth manned Gemini flight, scheduled for this fall with Cmdr. Walter M. Schirra as pilot and Maj. Thomas P. Stafford as co-pilot—now has definitely been assigned to carry out the first actual rendezvous and docking mission.

Out of a number of possible rendezvous flight profiles, the so-called concentric-orbit method has been chosen.

An unmanned Atlas/Agena D target vehicle and the two-man Titan II/Gemini spacecraft will have a simultaneous countdown at Cape Kennedy.

The target vehicle will be launched

[Continued on page 162]



To change orbits, Gemini uses 16 small thrusters (black dots show nozzles) on wide part of craft. Others on narrow nose aid in reentry.

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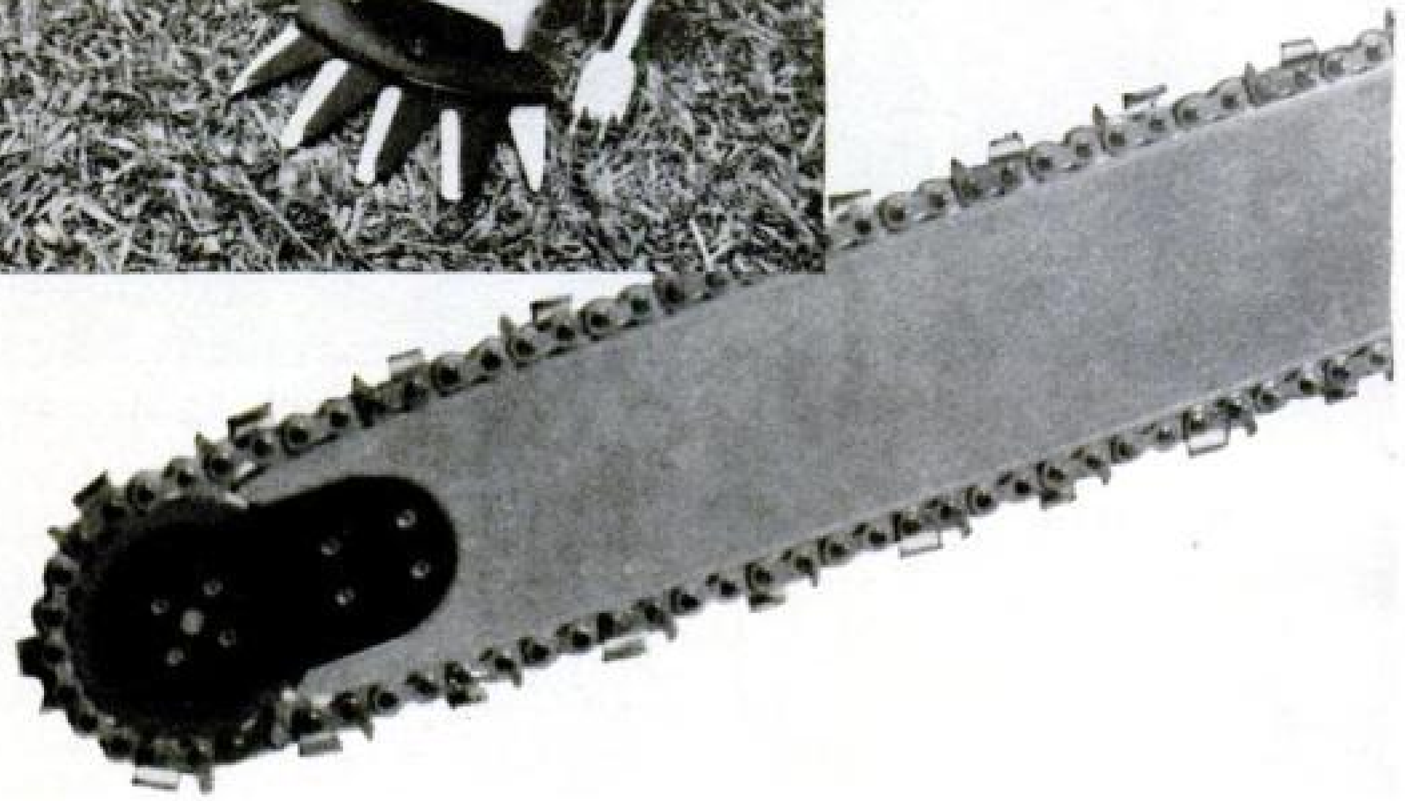
Small electric tools have super-strong plastic housings, insulating the user, eliminating the need for a grounding wire. Left to right: Rockwell's new trimmer, hedge clipper, grass shear. Clipper has saw tip for branches.



Let Electricity Ease Your

Electric yard tools, now safer, more rugged, more convenient,

By Jackson Hand

IF YOU'VE never considered electric power for big-job tools, this might be the year to do it. Electrical manufacturers have put a lot more power and convenience and safety into their equipment, and today you can use electricity for almost any job around the yard. Here are some of the most important developments:

- This season's battery-powered mowers will silently and efficiently handle an average-size lawn between chargings.
- The new insulated housings on hand tools don't need grounding, so you can use a two-wire extension.
- Motors are better for such hard-work jobs as snowblowing and yard vacuuming.
- A superb lightweight, heavy-duty chain saw has evolved from toylike models that burned out and from oversize models that took two men to operate.
- Best of all, contemporary plastic-covered underground cable is so cheap and easy to bury that you can run a line any place on your property.

Keep these points in mind when you shop for yard equipment. People who have used electric machinery are enthusiastic about it. Here are some of their reasons:

- The tools don't run out of fuel.
- They're clean.
- They're quiet. An electric lawn mower really needs a pilot light so you can tell when it's running.
- There is little or no maintenance.
- They start.
- They are easy to operate.

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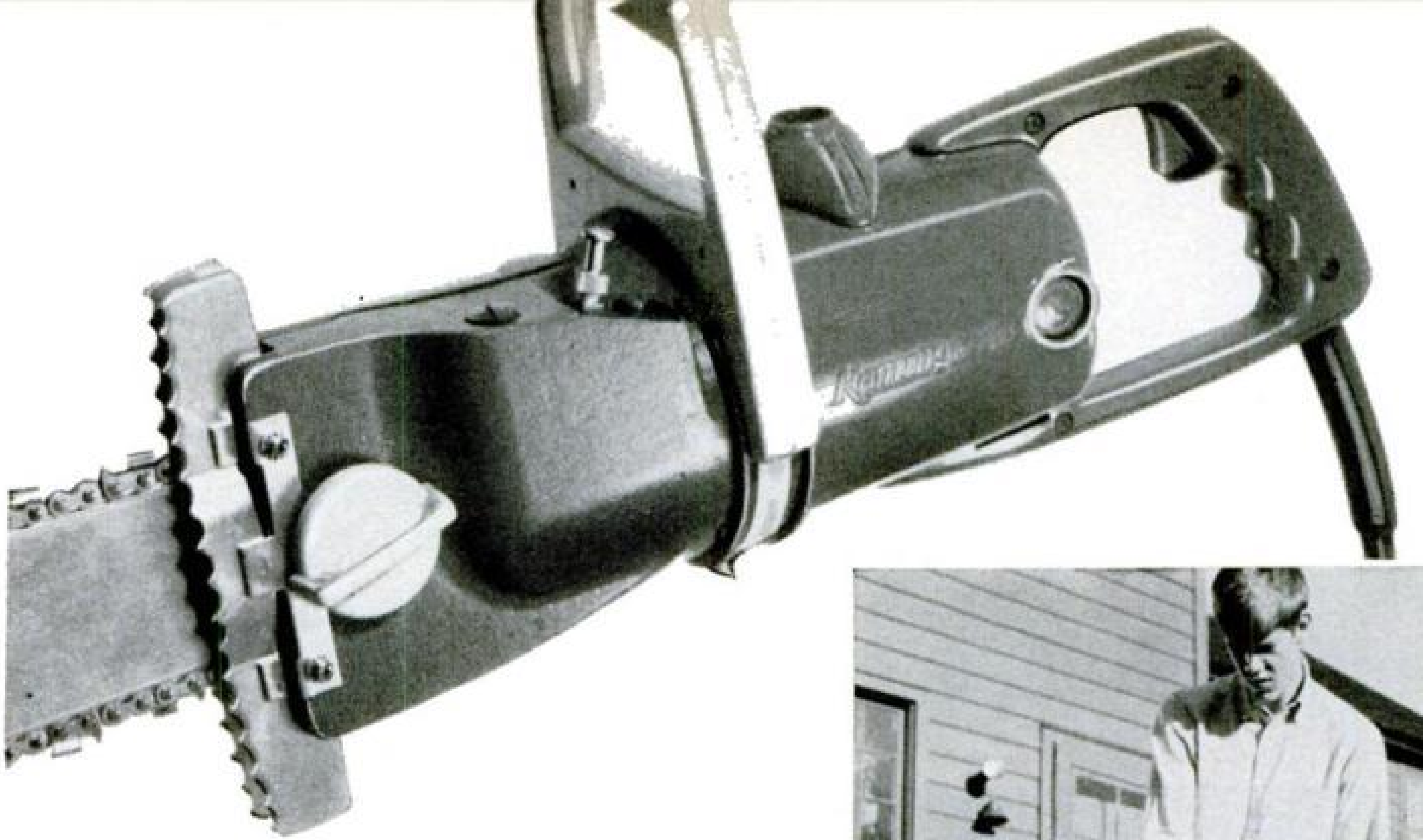

Yard Work

are ready for he-man jobs

On the other side of the scoreboard, it must be mentioned that people have been electrocuted using electric yard tools—the result, usually, of carelessness. But the danger becomes less each year as manufacturers improve their designs.

Two electric mowers. It takes five minutes to get used to the cord on a regular plug-in electric mower; there's nothing to get used to with the battery model.

With the electric, you mow back and forth—not around and around. Once you have wised up to the fact that you must come back on the same side of a tree, you're a pro. Some electrics have flop-over handles to facilitate the back-and-forth technique.

Features to look for:

- A brake to stop the blade so it doesn't coast interminably after you turn it off.

CONTINUED

This new electric chain saw made by Remington cuts even hardwood like butter, yet is light enough for a teen-ager to handle. A full-rotating handle lets you cut up, down, or sidewise.

Electric hoe is a big work-saver. Geared-down power of this Iron Fireman model drives tines, tears up the earth inches deep. An attachment for trimming cuts grass close to obstacles.

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Electric yard vacuum made by Thor picks up twigs, debris, grass clippings, leaves from lawn or driveway and earns separate keep as a workshop cleanup tool. A flexible hose reaches under shrubs and picks up clutter around flowerbeds.

How they make electric yard tools safe

1. Extension cords are marine type. Cords, positioned far outboard, never need to get in your way.
2. Housings of many hand-held tools are plastic, insulating all electrical parts. Non-insulated tools have a third wire leading to the ground.
3. Tools with no normal metal-to-ground contact, such as vacuums, are provided with metal drags—the same idea as the dangling chain on gasoline trucks.
4. Many rotary mowers have dead-man controls. Take your hands off the handle and the motor cuts off and brakes to a stop.

- Pilot light or some other on-off signal.
- Some sort of dead-man control.

This dead-man feature is important for safety. One of the best electrics has a foot switch—but it won't work unless at least one of two hand triggers on the handle is depressed. If you let go of both triggers, the motor won't start—or, if it's running, it will stop rotating in 10 seconds.

When you shop for an electric, you watch for all the regular lawn-mower features—short wheelbase, good maneuverability, easy height adjustment. You'll find the top capacity around 20 inches. Some of them have twin blades. There are reel-type electrics, too.

Cost: from $60 and up for a plug-in model, up to $125 or so for a battery model, including the charger (which also charges your car battery).

The electric chain saw. This tool has become so good that many rescue and disaster units now include a generator set and an electric chain saw. Today's best saws have motors designed specifically for saw use, with burn-out control and a thermal reset button. They have simple, straight-line design that gives them excellent balance.

Not long ago, electric chain saws were either too small to be worth much—or so big no home owner could consider one. Today, in sizes from about 10 inches up to about 20, the power range is about nine amps to 25. You can cut down a 12-inch

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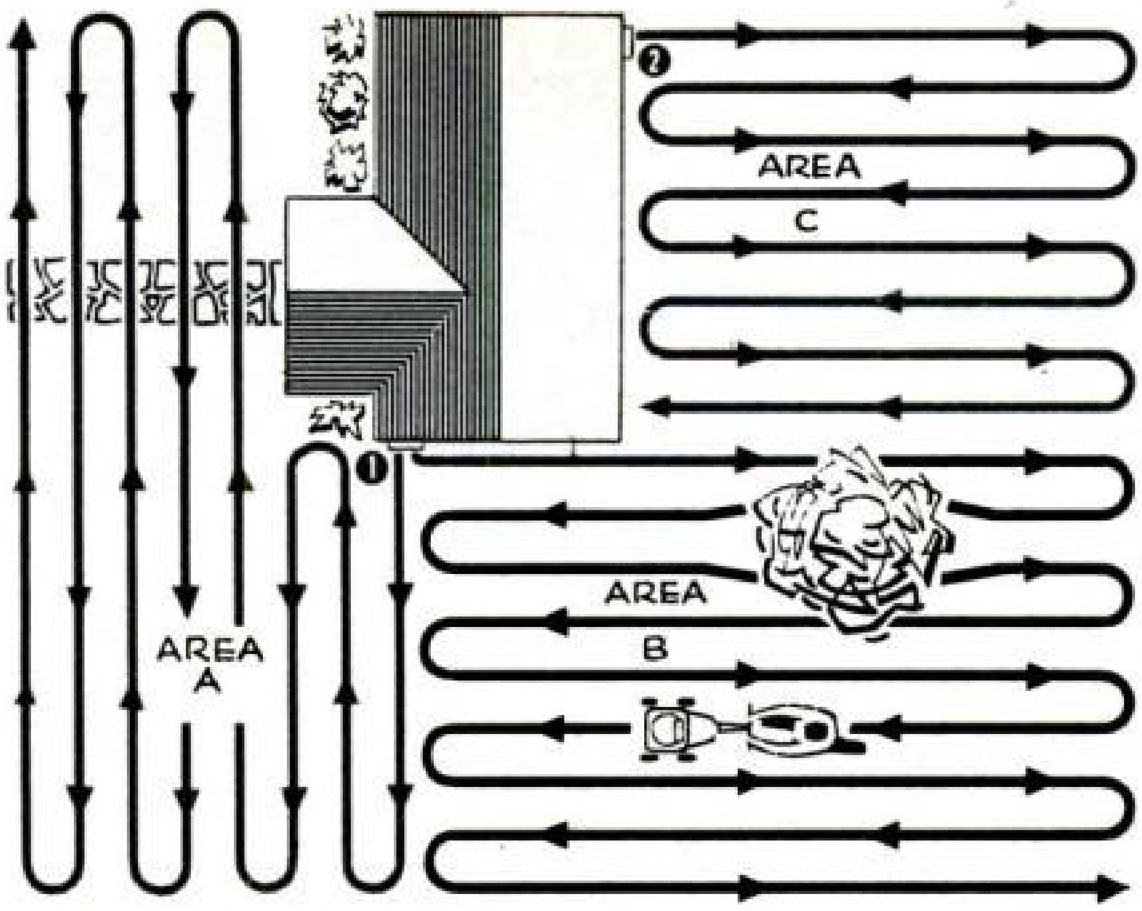
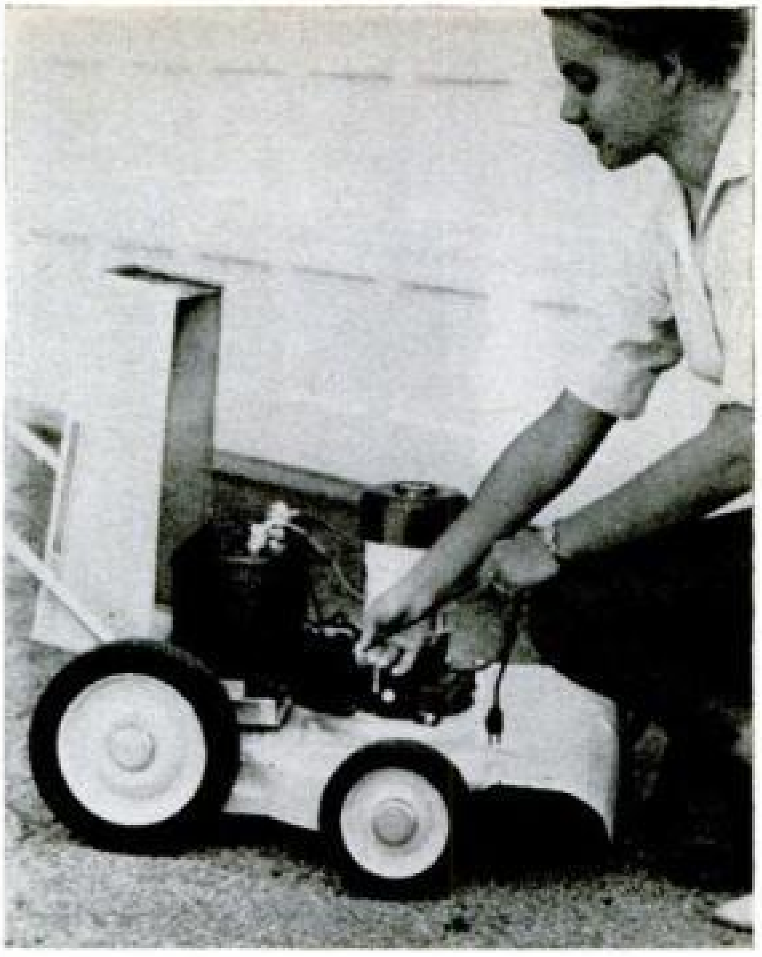


Electric cord on a plug-in lawn mower never gets in your way if you follow this simple mowing pattern. Plugged in at (1) you mow Area A, then Area B. Plug in at (2) and mow Area C. This way, the cord always trails away from you.



Battery-powered lawn mowers handle like any other except for the need to recharge the battery. Lambert makes this one. Some models have charger built in, with a reel-mounted cord to plug into any convenient 110-volt outlet.

tree in two or three minutes. You buck up a cord of fireplace wood in half an hour.

A major advantage possible with electricity is the on-off switch. If you're working up in a tree, for instance, you hoist the chain saw up with a rope, pull the trigger, and it starts.

Features to look for:

- Heavy-duty motor design.
- Fast chain speed, to minimize binding.
- Overload switch.
- Twist-lock plug.
- Chain oiler.
- Light weight—around 20 pounds.
- Handle designed for cutting sidewise, straight down, upside down.

Cost: as little as $60 for a small, light-duty model up to about $160 for a husky saw equal to any job. (There is also a chain-saw attachment for certain portable electric tools.)

Yard vacuum. The people who make electric vacuums for shop and home can—and do—make them for the yard, and they are efficient within their size limits, which is about 25 inches.

Features to look for:

- Adjustable nozzle height for work over grass or down close to paving.
- Easy-off, easy-dump bag (mildew-proof plastic is best).

Electric snowblower by Sunbeam is a small machine, about as wide as a snow shovel—but it moves about 250 ordinary shovelfuls a minute. Blowers weigh around 30 pounds.

- Anti-burnout motor.
- Pickup tube as an accessory—the handiest part of a yard vacuum, you'll discover. Low profile, for work under shrubbery.

Cost of a vacuum: about $130. ■■

NEXT MONTH: Wiring your outdoors

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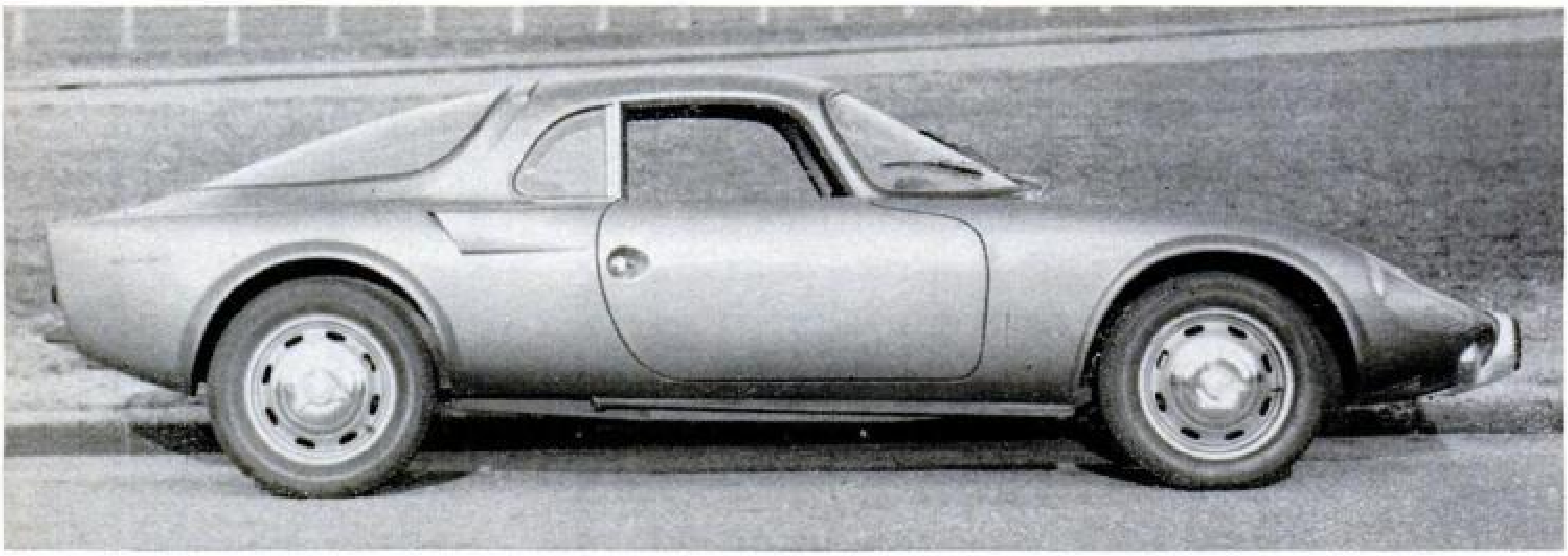
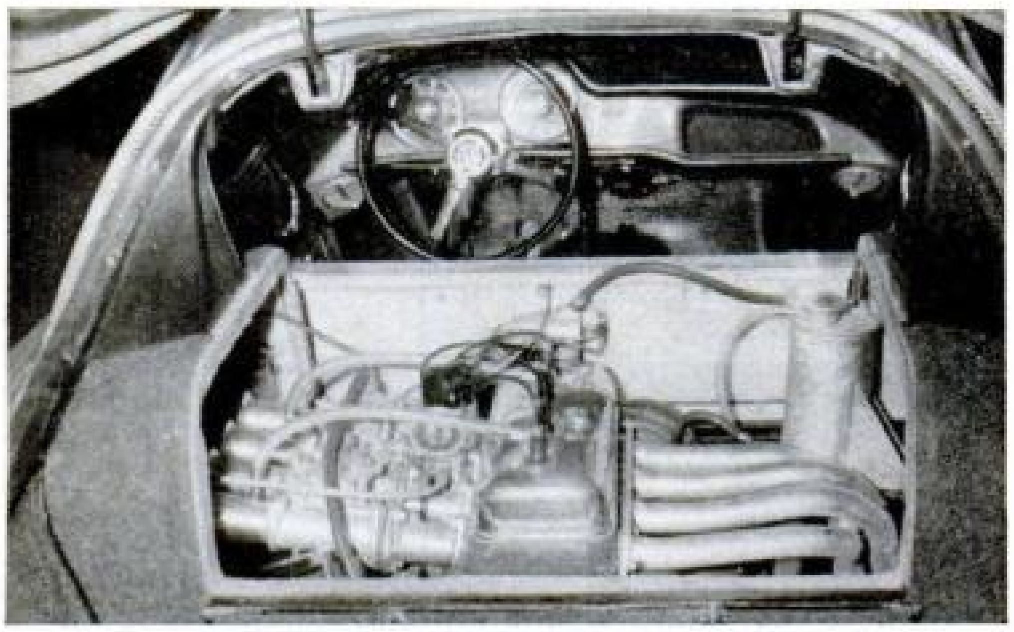




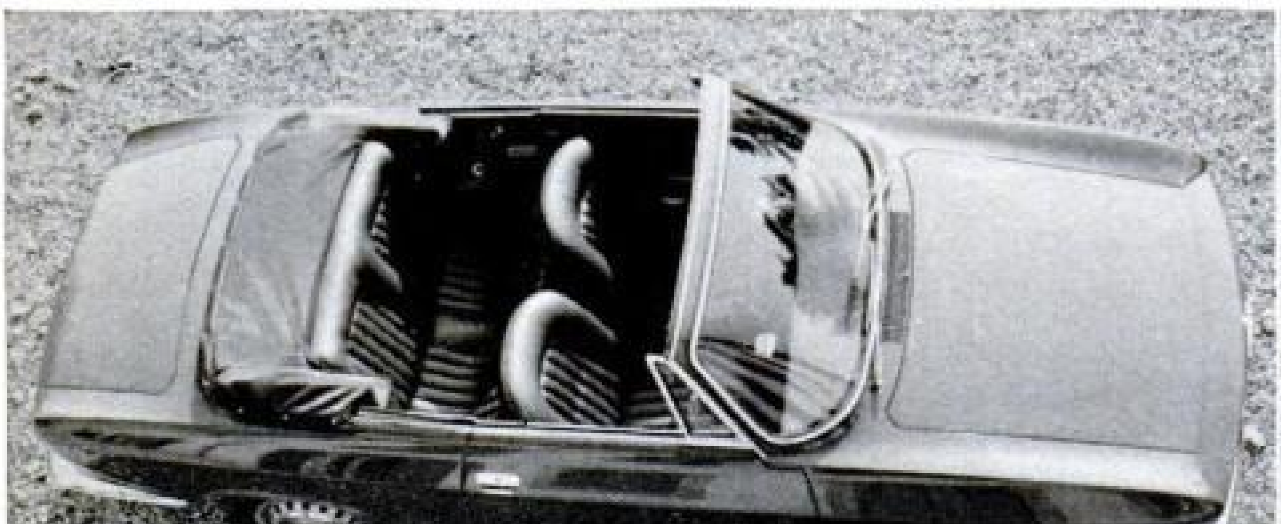
Engine and luggage share trunk

Mounted at the forward end of the rear trunk, the 67.6-cu.-in. engine balances weight distribution in the French wedge-nosed Matra Djet 5S. Output of the Renault power plant used is hiked to 94 hp. A cross-flow 10.2:1 cylinder head with two dual-choke Solex carbs is at one side, free-breathing exhaust pipes on the other. Cooling radiator, electric fan, and spare wheel are in the nose.

The 12-foot-long, two-seat body is on a tubular space-frame chassis. Speed is 120 m.p.h. A domed rear window lifts for access to trunk and engine.

New foreign cars come

. . . like droop-snoot fastback styling, a Ford-powered 150-m.p.h.



Alfa sports convertible seats four with ease

Alfa Romeo Sprint GTC, latest from the Italian makers, has a high-performance version of their 95-cu.-in. engine that delivers 122 hp. A twin overhead camshaft, light-alloy block and head, two dual-choke carburetors, and sodium-filled exhaust valves are featured. Body-contoured seats hold four without crowding. The top folds into a recessed pocket behind the rear seat.

Latest Fiat models show up

New Fiat babes, derived from the year-old 850, have their rear engines beefed up for man-size power. The 51.4-inch unit is energized by a Weber dual-throat carburetor, new camshaft,

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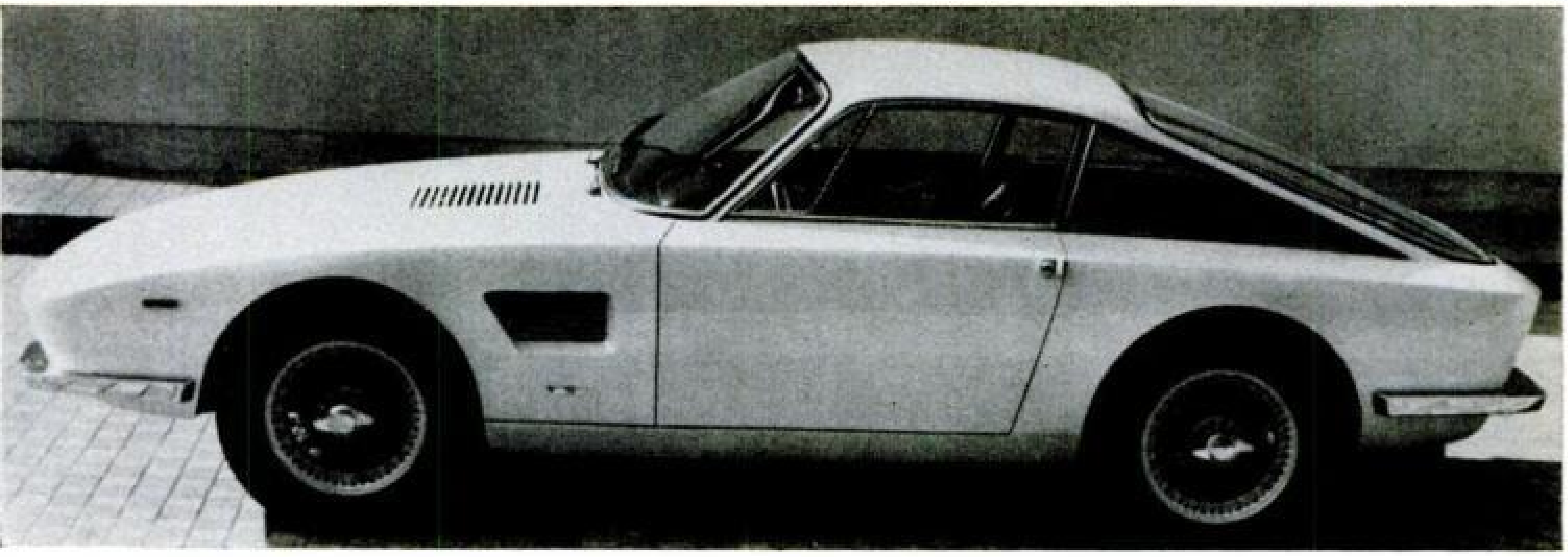

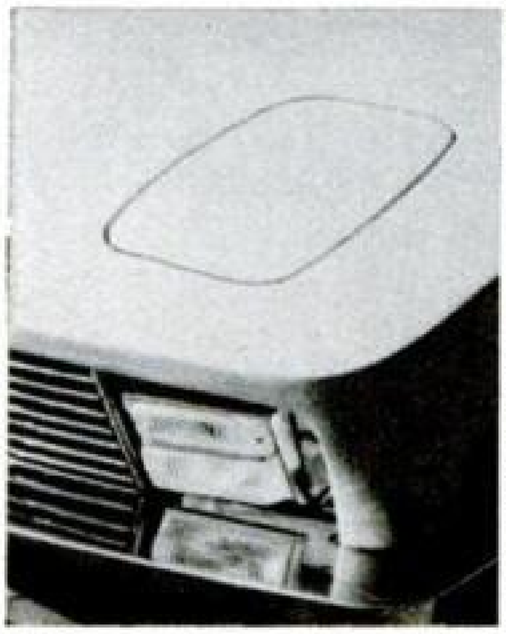

Ford V-8 powers hot fastback

T.V.R. Trident, multinational coupe, is built in England with a droop-snoot fastback body styled by Fiore of Paris and fabricated from steel-braced aluminum panels by Carrozzeria Fissore of Italy.

The engine is a 271-hp. Ford V-8 with four-barrel carburetor. A Borg-Warner close-ratio gearbox is followed by a Salisbury Powr-Lok limited-slip differential.

Refinements include electrically operated pop-up headlights, power windows, and thermostatically controlled cooling fans. The two-seater is 13½ feet long, four feet high, winds up to 150 m.p.n.

up with some surprises

coupe, pop-up lights, and an engine mounted smack in the middle

with sporting air

easy-breathing manifold, and high-compression head. Output is up to 52 hp., speed to 84 m.p.h. A two-seat Spider convertible gets two more horses with a hotter camshaft.

Italian two-plus-two has front-wheel drive

Lancia's Fulvia coupe, a four-eyed, square-tailed Italian only 13 feet long, has an enlarged 74-cu.-in. version of its unique narrow-Vee engine. The four-cylinder power plant with overhead camshafts and two twin-throat carburetors, puts out 80 hp., driving the front wheels through an integral transaxle. Occasional seats squeeze in two rear passengers for short rides.

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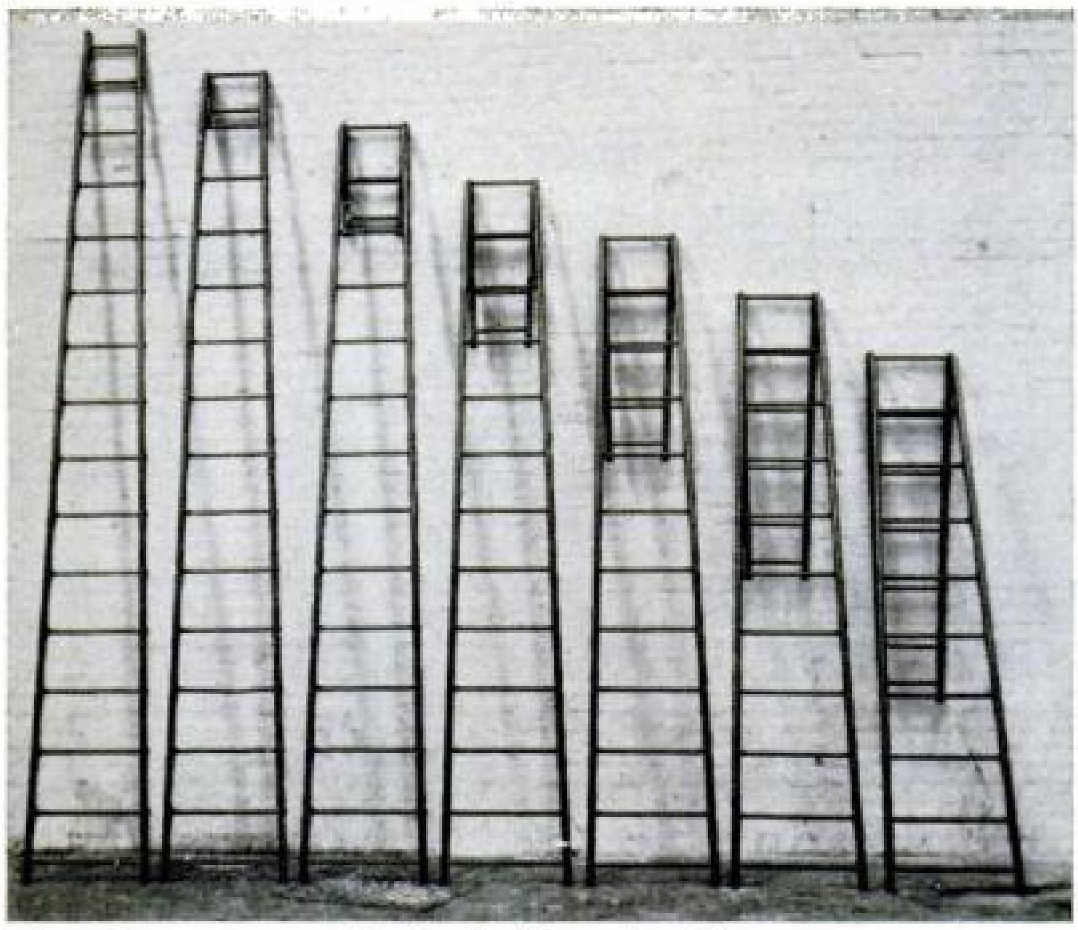
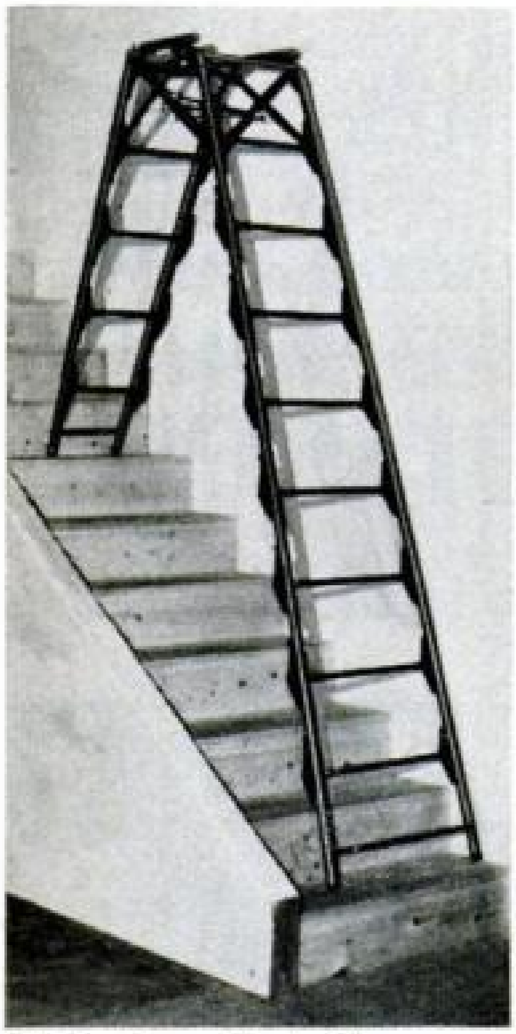


Placed against wall, the ladders bend at any rung to put any spot up to 12½ feet within easy working range.

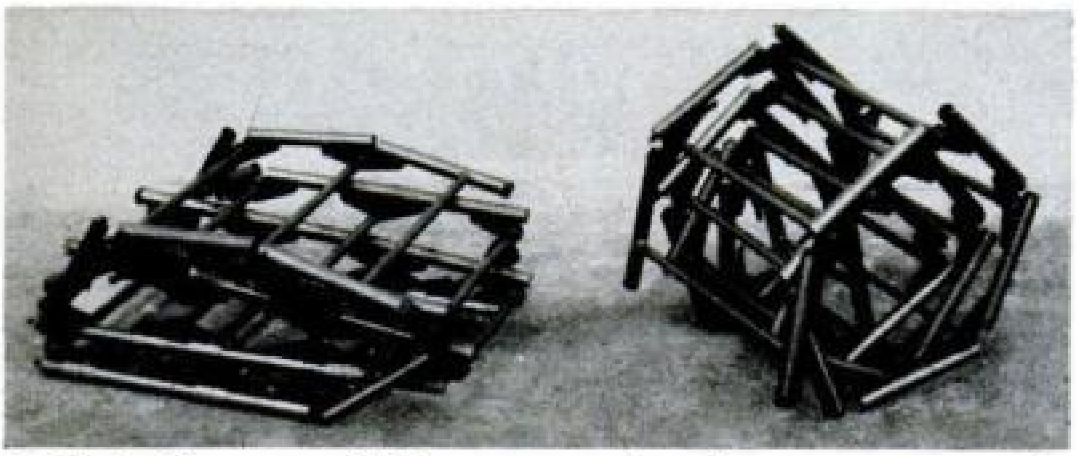


With legs locked at unequal lengths, it's safe to use for jobs on the stairway.

Jointed ladder bends for any job

A new kind of ladder, hinged at each rung, can be folded to any size or shape, used for outdoor work at its fully extended 12½-foot length or indoors as a stepladder. You can stand it safely on stairs, roll it up for storage or to go in a car trunk.

The hinges at the rungs of the British-made ladder are locked straight by a pin on a spring-loaded catch that automatically snaps into a mating hole when the sides are aligned. The joint is secured at the desired angle by cross brackets that fit into the hollow rungs.



Fold it flat or roll it to store in closet or car trunk.

Coin-operated car wash

This self-service car laundry gives British motorists 12 minutes of washing and rinsing for two bob (28 cents). A coin starts eight minutes of sudsing with detergent pumped through the brush. A second hose gives a rinsing spray.

There's also a vacuum hose [PS, Aug. '60] to clean inside the car—three minutes for seven cents.

Flexible lawn-mower blade

A nylon-and-neoprene blade for rotary mowers absorbs the shock of striking stones and debris. It will cut well for two seasons, the maker says, and can then be replaced.

The flexible Saf-T-Mow blade, ready to install with nylon driver to fit 18- to 25-inch mowers, costs $5 at K-D-B Enterprises, Decatur, Ill. Extra blades are $2.

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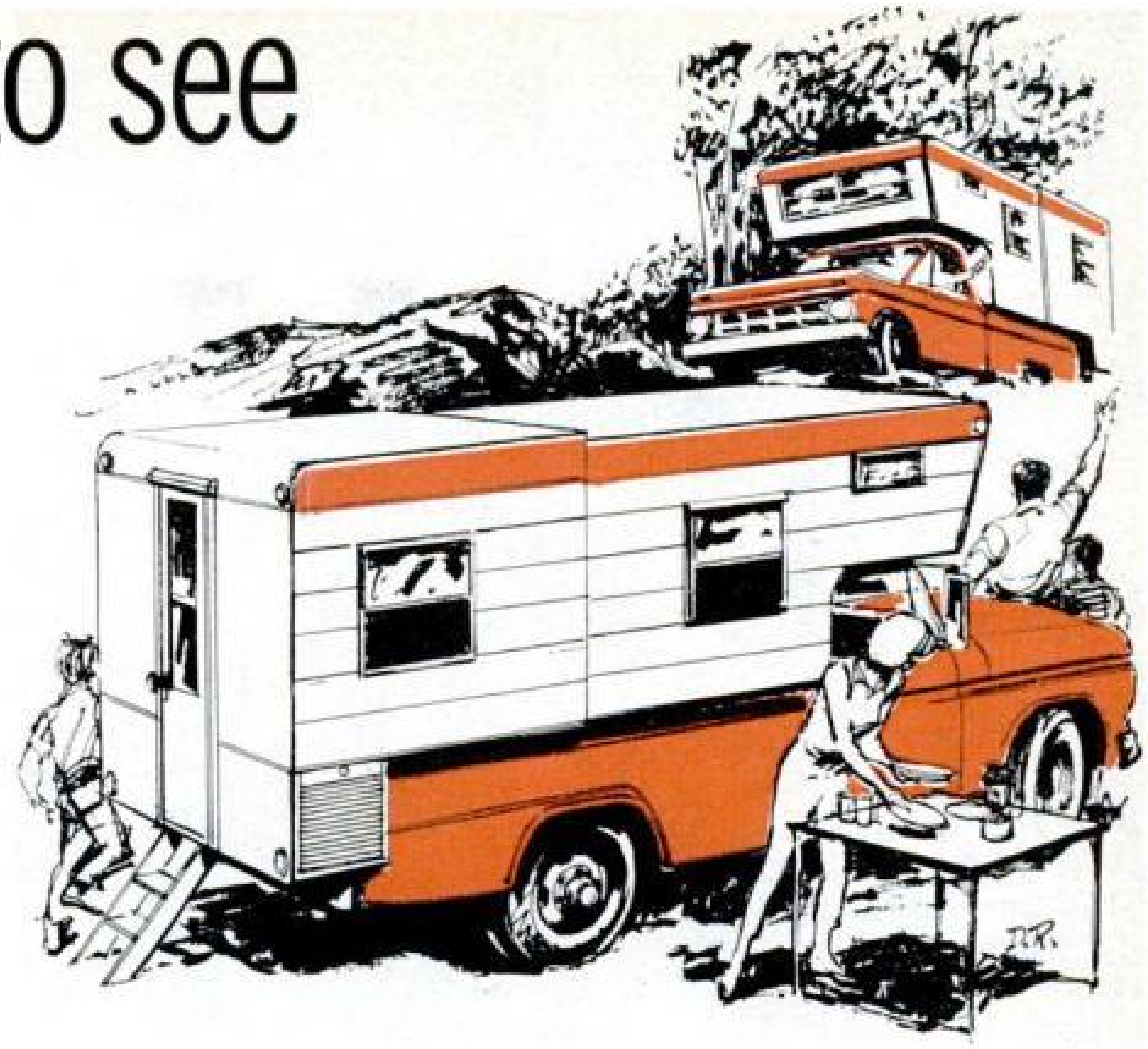
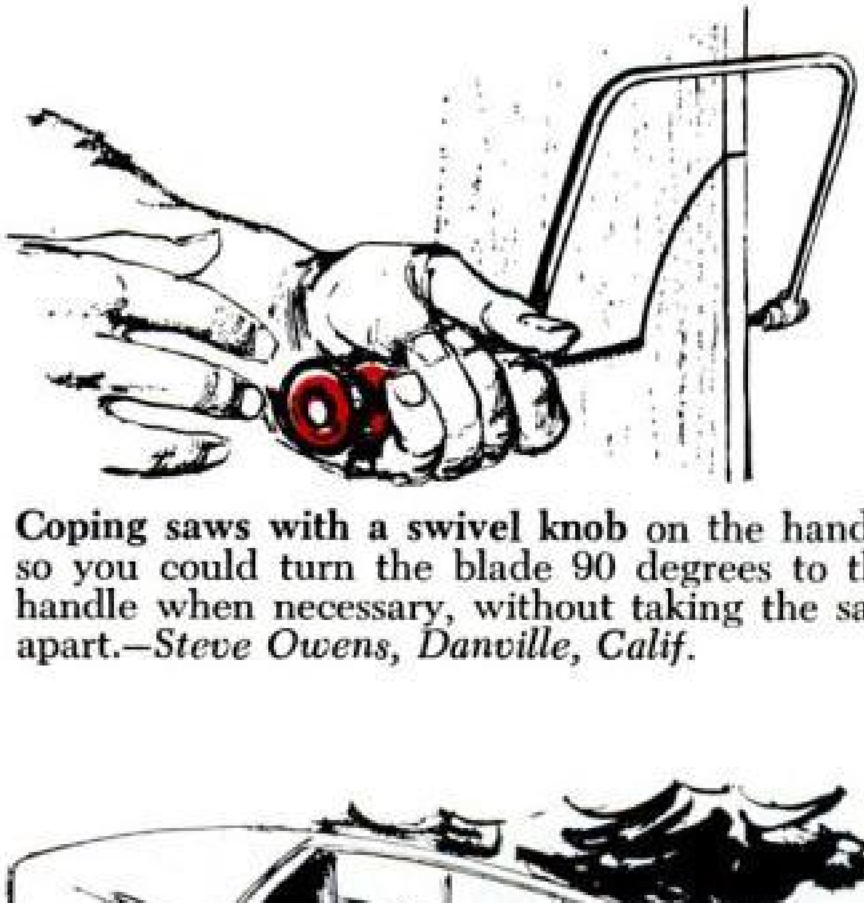
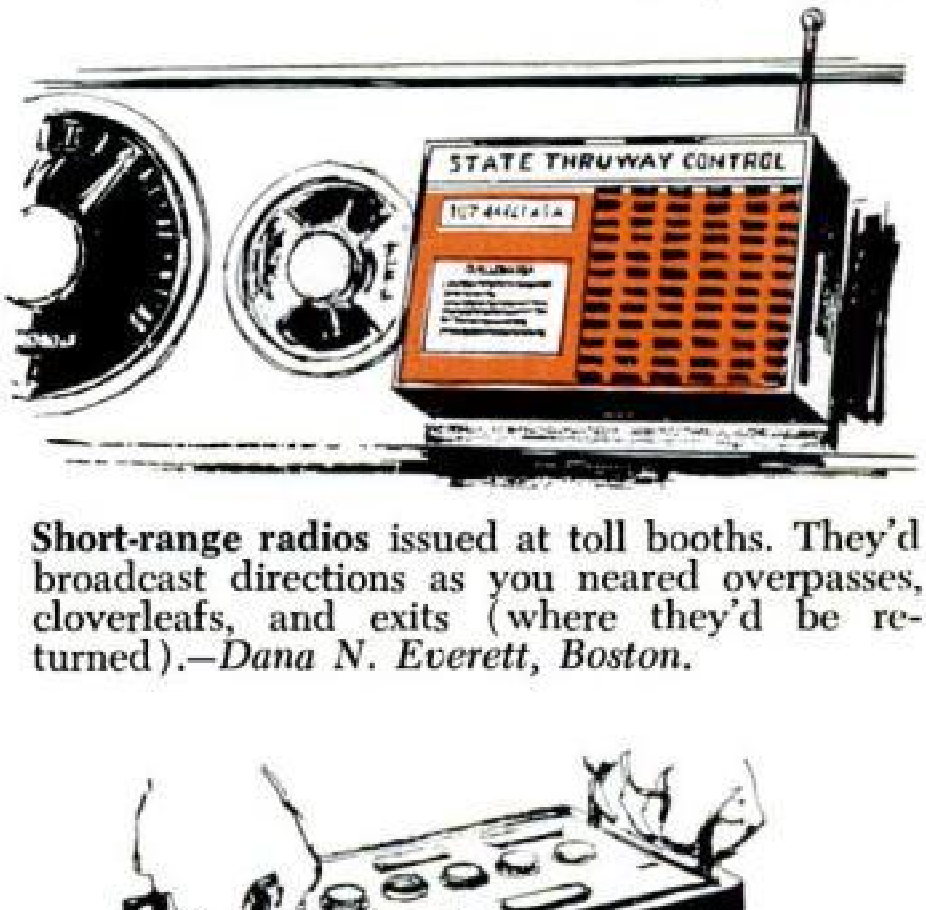
"I'd like to see them make..."



Piggyback campers to fit any size truck bed. They'd telescope, so you could make them longer or shorter as you can now make them higher or lower.—*H. Nugent, W. Terre Haute, Ind.*



Coping saws with a swivel knob on the handle so you could turn the blade 90 degrees to the handle when necessary, without taking the saw apart.—*Steve Owens, Danville, Calif.*



Short-range radios issued at toll booths. They'd broadcast directions as you neared overpasses, cloverleafs, and exits (where they'd be returned).—*Dana N. Everett, Boston.*

Safety throttles on outboard steering handles that would automatically shut off the motor when let go, stopping the boat if the operator went overboard.—*Ralph Dial, Miami Springs.*

Lift-out batteries with pronged recesses at the bottom that you'd plug into sockets in the battery holder. No cables to connect or disconnect. —*R. L. Wilzbacher, St. Paul, Minn.*

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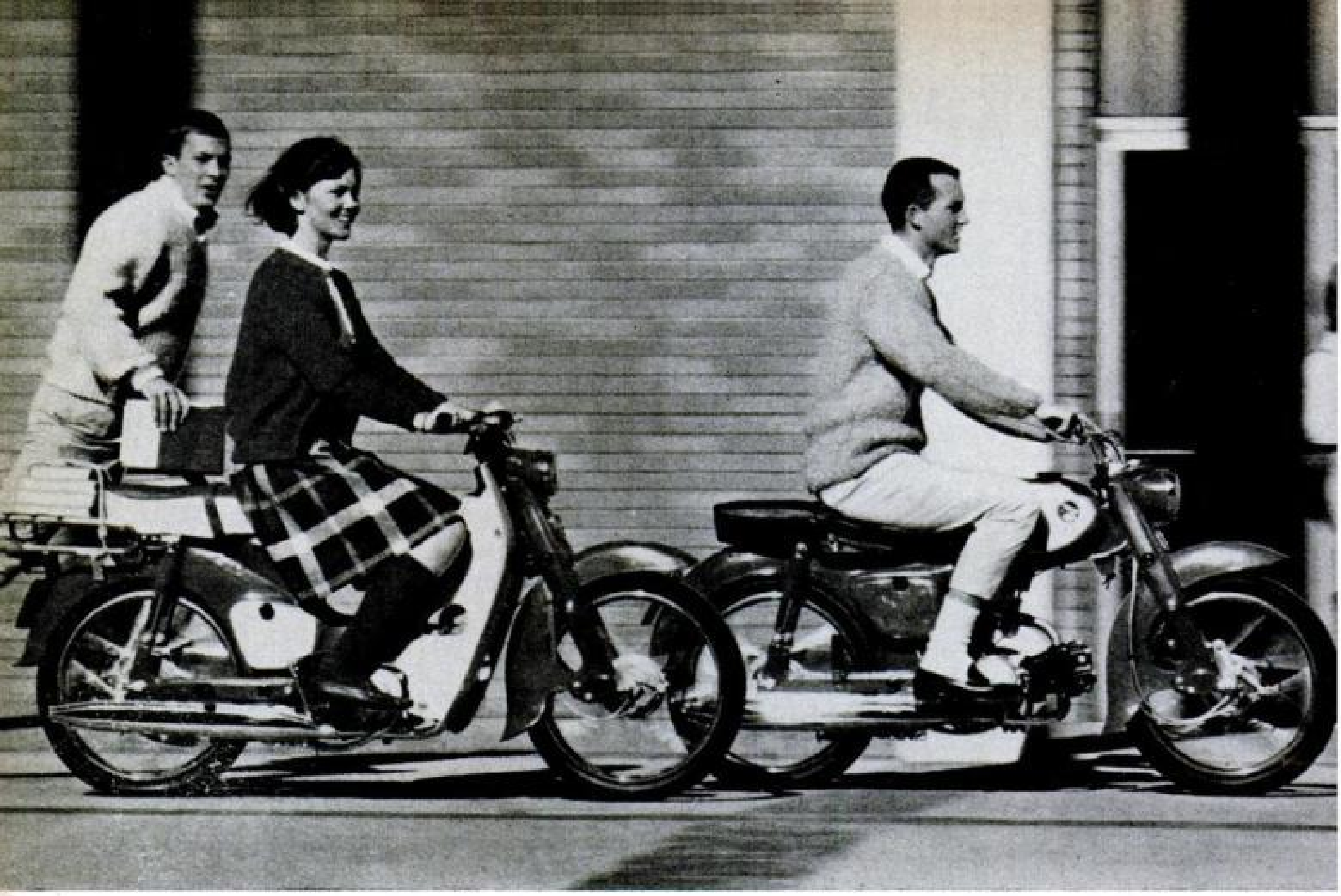

CIVILIZED CYCLES:
Everybody rides

Traffic? Parking? Expense? You can lick them all with a lightweight two-wheeler

By Erik Arctander

CHANCES are you've never seen your sedate, gray-haired Aunt Sadie from Kokomo on a motor scooter, but if the present trend continues, it might happen. Consider the following:

• In traffic-clogged New York City, more than one executive exchanges his homburg for a crash helmet at the end of the day. A two-wheeler can wind in and out between the stalled cars, and park in a shoebox-size parking place.

• More lightweight two-wheelers, both motorbikes and scooters, are being sold today than ever before. The little vehicles have gained new respectability as a means of transportation, thanks to clean, easy-to-operate designs that permit even the lady of the house to ride in comfort.

• The two-wheelers are the ultimate in economical motorized transportation. A number of popular imported models sell for well under $300, and a single buck spent for gas and oil will take you more than 300 miles. Registration and insurance may cost as little as $3 and $37, respectively.

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’em now

This isn’t the whole story, of course. Two important factors to consider are practicality and safety. Two-wheelers are more practical today than ever. An entirely new breed has flooded the market during the past two years, and there are currently over 50 different models of scooters and lightweight cycles for sale in this country at under $400. None are made here. Most come from Japan, Italy, England, West Germany—with a dribble from the Iron Curtain countries.

The new lightweights are aimed at enticing more millions of Americans onto two wheels (a million ride them already). In addition to their light weight, they’re easy to start and operate, comfortable, and stylish. Most seat two,

CONTINUED

College students lead transportation revolution. Californians at left are mounted on Hondas, which account for 60 percent of the two-wheelers sold in U.S. New lightweights like these are inexpensive.

Free parking is provided for the more than 800 students who commute on two wheels to the University of California at Los Angeles. Car owners have to pay for their space.

Modern two-wheelers are light on gas, comfortable, and clean to ride. These two men on the way to work are riding (left) an Allstate Compact and (right) an Allstate Moped model.

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These nine lightweight machines are low in price and

Ducati Falcon 50 has sporty lines of a racer.

Yamaha Riverside 55 engine uses rotary valve.

Allstate Moped is most like a bicycle. It has bike-size wheels and saddle, a set of pedals.

Harley-Davidson M-50 is closer to motorcycle than bicycle. It has smaller wheels, no pedals.

come with a parcel rack, have an enclosed chain, and muffle the exhaust with an effective silencer. Some have an enclosed engine, automatic clutch, leg shields, a step-through frame, an optional electric starter.

How safe are they? It all depends. You aren't likely to lose control and run off the road: Lightweight machines have a top speed of 35 to 50 m.p.h. and can be maneuvered with hairline precision. But you could spill on ice, wet leaves, loose gravel, or a poorly surfaced road.

The biggest hazard is having to share the road with four-wheeled vehicles. Main highways and expressways with their higher speeds and traffic densities are dangerous. You should probably restrict your two-wheel riding to secondary roads and local streets. Practice handling the controls until it comes automatically—before you brave traffic.

SPECIFICATION CHART

MAKE & MODEL	ENGINE DISPLACEMENT & TYPE	SPEEDS	WHEEL SIZE	WEIGHT (lb.)	PRICE (FOB)	DISTRIBUTOR
Allstate Moped*	50-cc. two-stroke	2	23"	104	$199 (Chicago)	Sears, Roebuck
Ducati Falcon 50*	50-cc. two-stroke	3	18"	108	$215 (New York)	Berliner Motor Corp., Hasbrouck Heights, N. J.
Honda 50*	50-cc. four-stroke	3	17"	121	$215 (Los Angeles)	American Honda Motor Co., Gardena, Calif.
Harley-Davidson M-50	50-cc. two-stroke	3	18"	103	$225 (Milwaukee)	Harley-Davidson Motor Co., Milwaukee
Suzuki M-31*	55-cc. two-stroke	3	17"	123	$245 (Los Angeles)	U.S. Suzuki Motor Corp., Santa Ana, Calif.
Yamaha Riverside 55*	55-cc. two-stroke	4	17"	148	$249 (Los Angeles)	Yamaha International Corp., Los Angeles
Vespa 50	50-cc. two-stroke	3	9"	155	$269 (Boston)	Vescony, Inc., Boston
Allstate Compact	60-cc. two-stroke	3	12"	154	$285 (Chicago)	Sears, Roebuck
BSA Red Flash	75-cc. four-stroke	4	17"	140	$289 (New York)	BSA, Inc., Nutley, N. J.

*Lowest-priced of several models under $300.

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widely available throughout the country

Vespa 50 has a typical scooter layout. Engine is aft, under the seat. Wheels are the smallest of any two-wheeler. Center section is low, flat.

Honda 50 is a motorcycle with scooter-type shielding. Engine lies in tunnel formed by the two leg shields, is air-cooled and has an automatic clutch. Saddle seats two, has passenger strap.

Allstate Compact has the full shielding of a scooter, but fan-cooled engine is amidships under gas tank. Wheels are scooter size.

BSA Red Flash has the largest engine, a 75-cc. four-stroke with a four-speed transmission.

Suzuki M-31 looks very much like the Honda 50, but is powered by a 55-cc. two-stroke engine.

Don't think you will be conspicuous riding around on a two-wheeler. The little vehicles are acquiring their second veneer of respectability in a decade. The first was applied during the scooter boom, when the chic styling of Italian imports encouraged many young people to try two wheels.

Honda, the Japanese lightweight motorcycle, has been responsible for the second. Its ambitious advertising campaign has convinced many that "you meet the nicest people on a Honda." Honda sells 60 percent of the two-wheelers bought in the U. S.

Buying a two-wheeler. If you're convinced that a motorbike or scooter will make a perfect second or third vehicle, the first step is to look over and carefully compare the nine machines listed on the facing page.

Among these machines you will find four basic styles. Two, the Allstate Moped and the Harley-Davidson M-50, look like open-frame bicycles with engines and gas tanks grafted on. The Moped (short for motor-assisted pedal cycle) is the only machine with pedals and bicycle-size wheels. The pedals start the machine and can take over if the engine conks out. The M-50, despite its appearance, is a full-fledged motorcycle; it has no pedals.

Two other machines, the Vespa 50 and the Allstate Compact, are scooters. They have the smallest wheels, concealed engines, and leg shields that curve backward to become footboards. You get excellent protection from engine and road dirt, and a distinctive appearance that belies the two wheels. You pay for these advantages with a higher price and performance-reducing weight and wind resistance. The Vespa, more scooter-like of the two, is especially suitable for women who wear skirts while riding.

The Honda 50 and the Suzuki M-31

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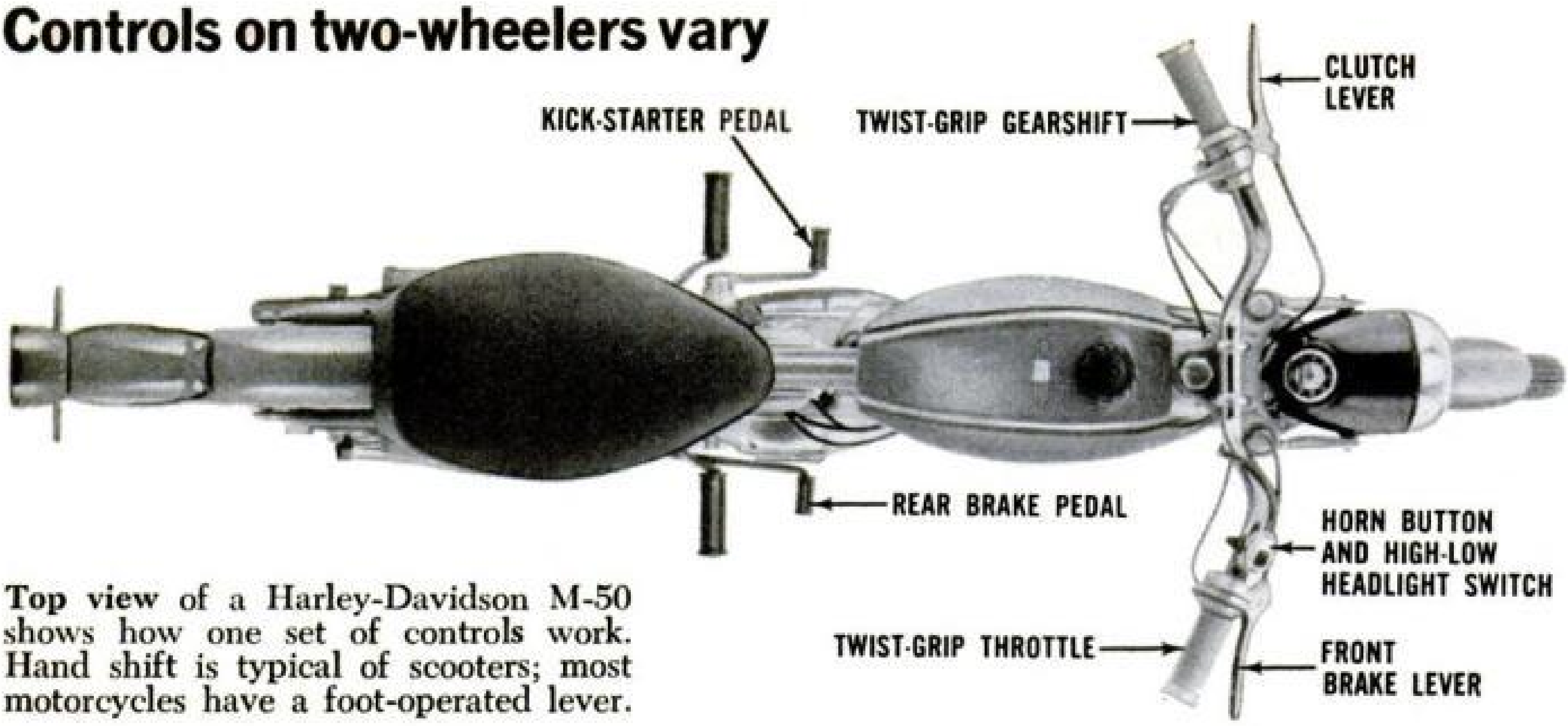
Controls on two-wheelers vary



Top view of a Harley-Davidson M-50 shows how one set of controls work. Hand shift is typical of scooters; most motorcycles have a foot-operated lever.

are hybrids. They have the large wheels and forward-mounted engine of a typical motorcycle, but a step-through frame and leg shields reminiscent of a scooter. They provide motorcycle handling and performance with scooter protection from dirt.

The last three—Ducati Falcon 50, Yamaha Riverside 55, BSA Red Flash—have typical motorcycle layouts. If you want performance rather than a sedate appearance, these three are good bets. Two of them have four-speed transmissions, for example.

Two-cycle vs. four-cycle. You will notice from the chart that seven of the machines have two-stroke engines, and two have four-stroke engines. A two-stroke engine is simpler (it has no valve gear or pressure oiling system), and costs less to build. Fewer parts mean fewer things to go wrong, too. On the debit side, a two-stroke needs its oil mixed with gasoline. This means some inconvenience, a smoky exhaust, the possibility of oil fouling the carburetor and spark plug.

A four-stroke engine is more efficient, especially at lower speeds, than a two-stroke. It uses less oil, starts with less fuss, makes less noise. A four-stroke's valves *can* cause trouble, however, especially if they are over-revved.

Learning to ride. It takes a bit of practice to ride a powered two-wheeler even if you already know how to ride a bicycle and drive a car. But anyone with normal intelligence and dexterity can learn to ride in half an hour or so.

Controls vary from one machine to another, but are easy to handle once you've gotten the feel of them. Throttle, clutch, and front brake are hand-operated. Kick-starter, rear brake, and (usually) gearshift are foot-operated. Once under way, you shift and brake without taking your hands off the handlebars or your feet off the pegs.

Two points about controls: The usual foot-shift lever will scuff the toe of one shoe. You can glue a soft cloth around the rubber or choose a machine with hand-shifting (Allstate Moped, Harley-Davidson M-50, Allstate Compact). And if a woman will ride the machine, you should have her try the clutch lever. A stiff one will give her a cramped forearm if she must shift constantly in heavy traffic. On the Honda 50, incidentally, you shift with one toe and an automatic clutch does the rest.

Four of the nine machines (Allstate Moped, Ducati Falcon 50, Vespa 50, Allstate Compact) have fan-cooled engines. Fan cooling is necessary on scooters, where the engine is hidden by body panels. But most two-wheelers get along without this extra bit of machinery. Unless you plan to commute through Death Valley you probably shouldn't let fan cooling exert a strong influence on your choice of a machine. ■■

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Long-wheelbase Dodge D-200 with six-man cab and eight-foot bed converts into a mobile home.

New Pickups Carry Six Up Front

CAMPING enthusiasts have very special needs in all kinds of equipment. Heavy camper units require special trucks, and two auto makers, Ford and Dodge, are now offering six-passenger, four-door pickups designed for the recreation-minded buyer with a large family. The Dodge Crew Cab pickup is based on the D-200 chassis; the Ford is available in both the F-250 and F-350 series. The Dodge Sweptline cargo box is eight feet long, with a 65-inch tailgate that accommodates all normal camper bodies. Ford offers both Flareside and Styleside bodies. For heavy camper units, Dodge recommends the 200-hp. 318-cu.-in. V-8 engine, Ford the 208-hp. 352-cu.-in. V-8. Both offer a choice of manual or automatic transmissions.

Dodge's basic camper package includes heavy-duty springs front and rear, power brakes, increased engine-cooling capacity, 59-amp alternator and 70 amp-hour battery, an oil pressure gauge, and dual outside mirrors. Ford has an even wider choice of options, to cater not only to farm families and vacationers but also to construction, utility, and service firms with large crews.

Ford's crew-cab F-250 combines best features of airport limousines and heavy-duty pickup trucks.

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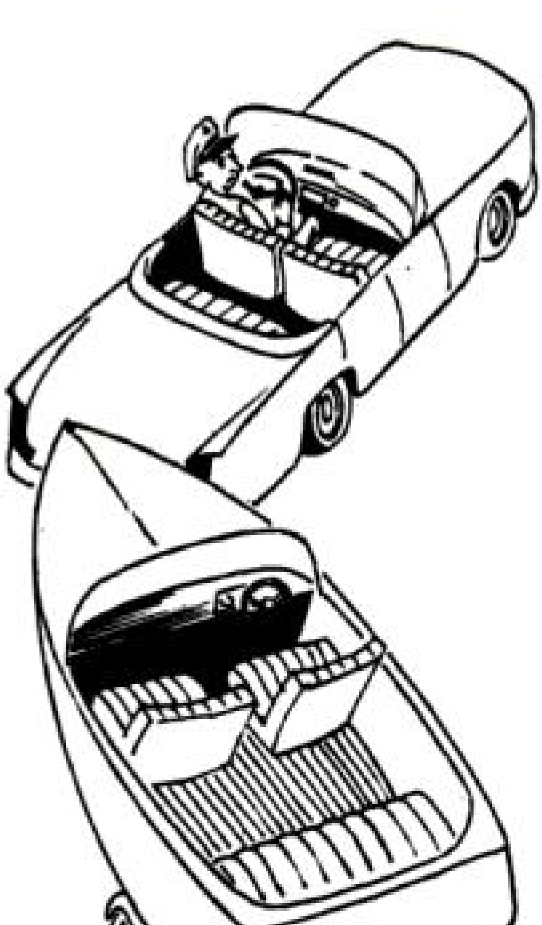
PS BOATING

Tricks with Trailers

A trailer is your magic carpet to new and adventurous boating waters. Ideas like these make trailering a breeze

By Jim Martenhoff ILLUSTRATED BY CARL ROSE

To back your trailer, steer from bottom of the wheel. Want the trailer's rear to go left? Push left. Right? Push right.



But not too far! If you do, you will jackknife trailer and end up in the petunias.

BOAT trailers aren't really temperamental—they only seem that way to novice outboard owners struggling to back the family boat into the back yard. Then a boat trailer seems to come alive and display a mulish personality—throwing a tantrum and obstinately backing into areas where you particularly did not wish it to go. A lot of innocent shrubbery has fallen victim to willful trailers.

But backing a trailer is one of the easiest tricks to learn. Just steer with the *bottom* of your car's steering wheel.

That's all there is to it. When you want to back your trailer, simply put your hands on the bottom of the steering wheel. To back the trailer toward the left, push the bottom of the wheel left. To back right, push right.

One other rule is important to remember: Do not oversteer. Don't leave the steering wheel hard over as you back, or you'll jackknife the trailer. If you make that mistake, pull forward to straighten out, ruefully examine the rose bushes edging the driveway, and try again. This time, easy does it. Turn the wheel a bit at a time.

Most men, and quite a few women, speedily learn that a trailer adds a lot of length to the automobile that's towing it. They adjust rapidly to the passing, parking, and turning situations constantly arising. Extra room must be allowed when you pull out to pass another car or when you park, and you must learn to swing a little wider on those corners.

The all-around view. Be sure you have adequate rear-view vision. Install side-mounting mirrors on your car, and select towing mirrors with long arms if you have an unusually large boat. There should be mirrors on both sides of the car; you need rear vision on the right when passing.

But no mirror provides back-of-the-boat vision. There will always be a small dead spot directly aft of your rig. A tailgater riding close herd could escape notice.

Here are two tricks that will help you keep tabs on following traffic:

1) Make it a matter of automatic habit to glance frequently at your mirrors—every 20 or 30 seconds. The man who does so is a safer driver whether towing a boat or not;

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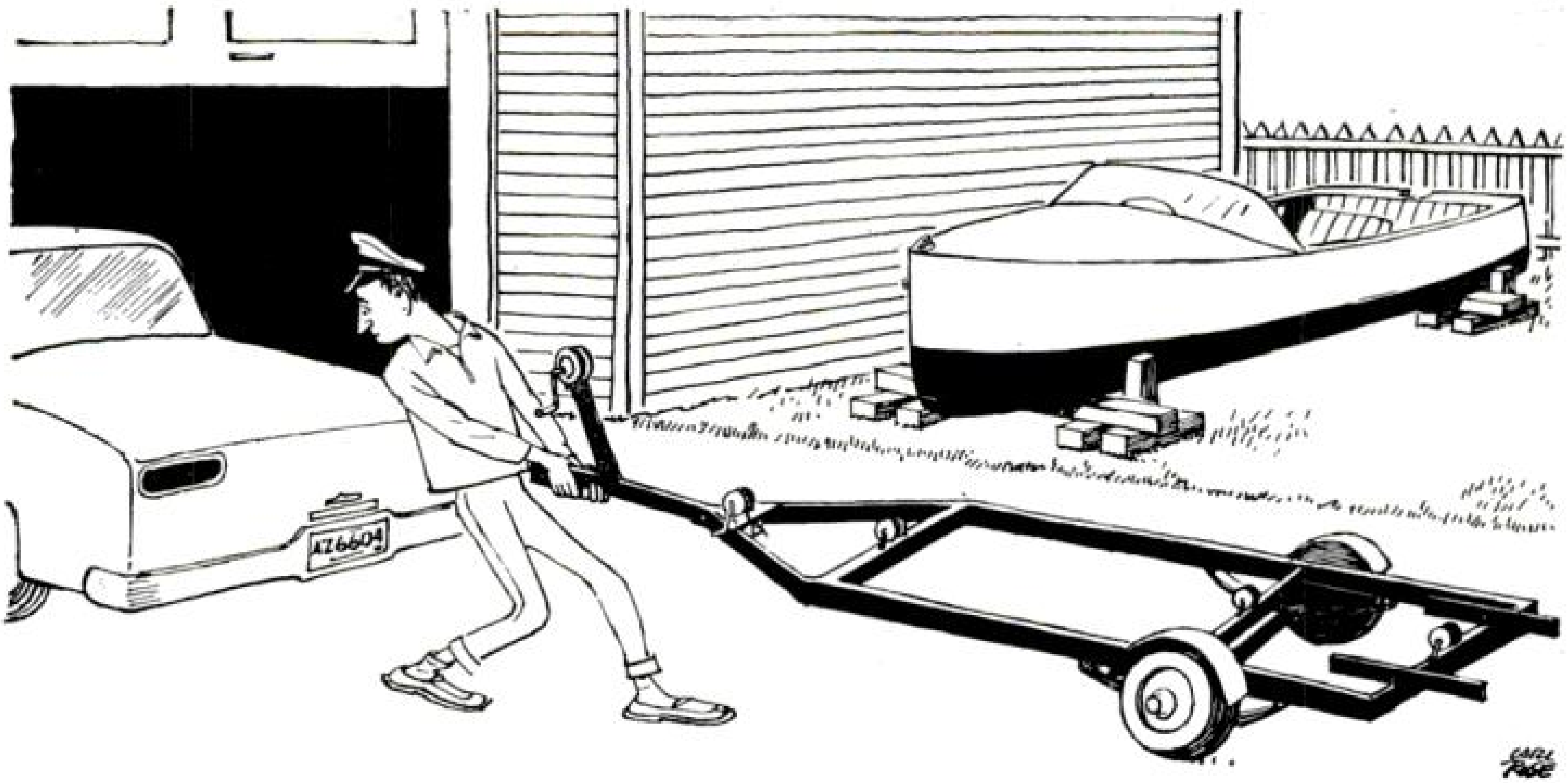

keeping tabs on changing traffic situations is a basic rule of defensive driving—the safe way to operate on the highways. You'll spot any problem as cars move in behind you.

2) Make a tiny jog on the highway every now and then, especially if you have reason to suspect a tailgater. Ease to one side, and drift back again. This maneuver will pull the trailer briefly to one side, giving you an opportunity to look directly back into that blind spot.

Two other highway tricks for safer, more relaxed towing:

1) Always watch the traffic far ahead, keeping alert for changing situations. It could be a traffic light, a blind side road, or a crowded one-lane movement through an area under repair. Whatever it is, watch for it.

2) Don't be trapped in the wrong lane by traffic. Don't pull out to pass a slower vehicle when there's a possibility of traffic lights, blind curves, or side roads ahead. (A lot of thoughtless drivers pull out of side roads without realizing that an unseen passing situation coming at them could block both lanes.)

Distributing the load. Even the novice outboarder knows his boat must be loaded correctly on the trailer. Too much weight aft and the trailer will develop a tendency to wiggle under way. She'll dance a hula on the highway, swaying back and forth.

The answer, of course, is to set up the trailer so there is adequate tongue weight—at least 50 pounds of weight at the tongue forward, but not over 100. Too much weight there is hard on the car springs and shocks, and overload springs are necessary. An extra two pounds of air in the rear tires helps, too.

Balancing a rig for towing is not a critical task, and it's a rare boat that hulas all the way home from ramp or fishing camp. But it is not unusual for careless stowage to produce a faint, bothersome, occasional hula. Sometimes, all it takes to upset the balance is a load of fish in a box at the stern.

If you should be plagued by an *occasional* tendency to hula on the part of the trailer, here's how you can control it and keep going: Just steer against the swaying, with tight,

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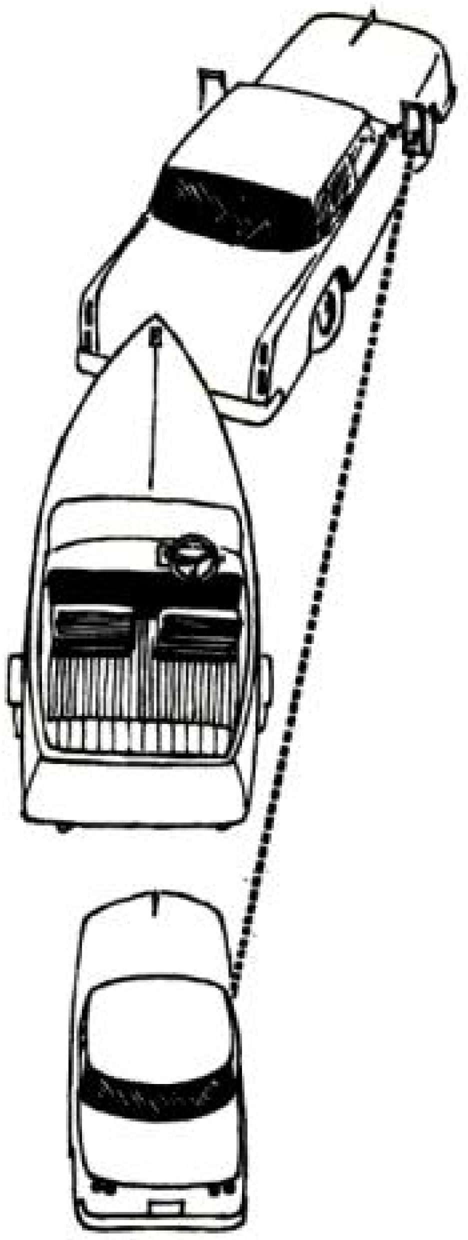

A right-hand mirror comes in handy on turn-offs, or when you're passing another car.

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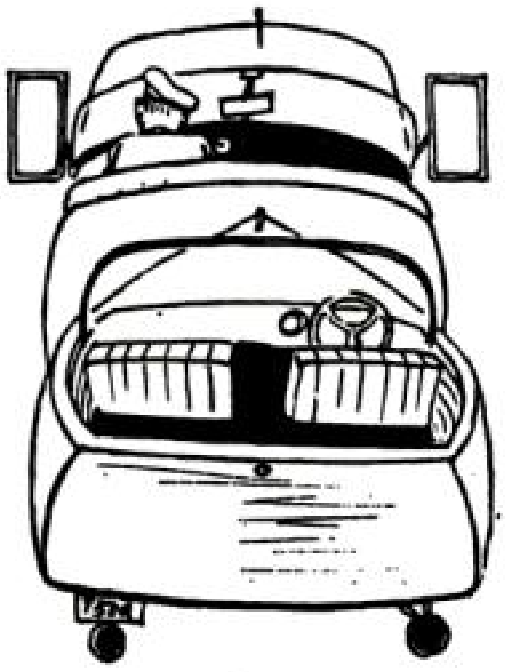
tiny movements of the steering wheel—matching the rhythm of the swaying trailer. Any good driver can master the knack the first time he tries it. It kills the swaying every time.

If you have a long tow ahead of you, you should pull off and reload the boat to stop any tendency toward sway. But on short hauls, especially on narrow roads with insufficient shoulder room for safety, this jogging of the steering wheel—but easy, now—does the trick.

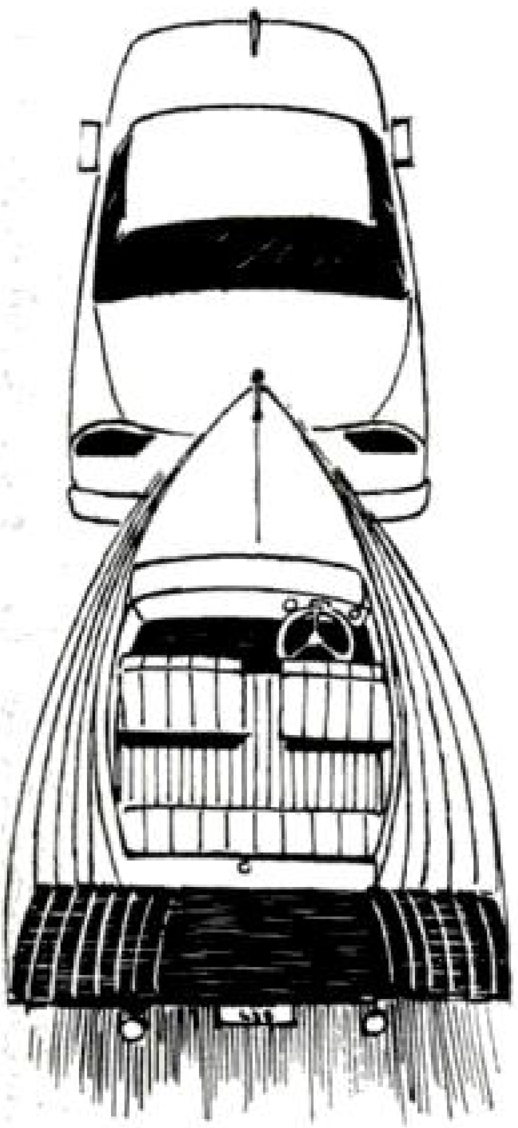


Expert trailer boatmen constantly check rear-view mirrors. It's a necessary defensive-driving technique.

Preventive maintenance. Virtually everyone understands that trailers, like autos and boats, demand maintenance and care. Advice of this kind is easily come by, for it is often repeated by dealers and by fellow boatmen who learn, even as you and I, that rust and corrosion must be prevented rather than cured.

But a once-over-lightly on prime points wouldn't be amiss, especially where a little know-how takes the work out of it:

- Watch your tire pressures. It only takes a few minutes to check the tires at your neighborhood service station. Take a small paintbrush and letter the required tire pressure for your rig right on the trailer somewhere. If you don't, and you forget the figure, file this in your memory: Nearly all trailer tires take at least 50 pounds of pressure and sometimes more. Never put in less than 50 pounds. Make it a point to check toe-in, too. Sometimes trailer tires get out of alignment, and wear is expensively rapid.
- Never neglect the wheel bearings. Check these, too, at your service station. Every outboard skipper has seen what happens to the man careless of the bearings—a broken-down rig parked on the shoulder of that road to the beach; maybe with wife and child watching it while dad is off grimly in search of assistance.
- Keep an eye out for rust. When it shows up on the trailer, sand immediately and touch up with aerosol-spray paint in a matching color.
- Watch for corrosion—around salt water especially. It often shows up first in sticky rollers. Tip: Drop a bit of oil on the rollers every other time you launch the boat and they'll never stick.
- And take care of that winch. Too many outboarders don't. Unwind the cable every now and then; look for rusted, rough spots on the reel of the winch, which could abrade the cable and cause later breakage. A broken cable, if snapped under load, can whiplash back to the car to damage it or cause personal injury. Be sure cable and winch are in good condition by checking several times a season.



Boats are supposed to float—not dance the hula. If yours jiggles and bobs on the trailer, rebalance its load.

A little preventive maintenance keeps the trailer in tip-top shape and spares you a heavy work session—which is sure to occur if you let things slide. One of the smartest tricks with trailers is to handle maintenance as you go, avoiding that big buildup of chores.

Ever unhook a trailer and drive the car away without disconnecting the lights? It happens now and then, producing electrical confusion while the repentant skipper sweats over getting the right wire back in the right connection. It's easy to keep it all straight if you remember that trailer-lamp wires are color-coded by industry standards. And the color code is simple for a boatman to keep in mind:

The red wire is for the left turn light. Red is the color

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of the port (left) running light on the boat, so it's easy to remember.

The green wire is for the right turn lamp—and green is the color of the right, or starboard, boat light.

Black or brown is stop, and white is for ground. (Snow is white, snow is on the ground. Helps you remember.)

Keep the color code in mind. It'll help you treat wiring problems. And if your trailer wires aren't color-coded, then tag 'em. Tie identifying tags on each wire. Some day you might be glad you did.

Launching—with no sweat. Last, but not least, a few launching tricks worth knowing:

If you have a very heavy rig, you've learned to hate launching. Recovery—especially with a power winch—is already a breeze. But it takes muscle and sweat to manhandle that hull *off* the trailer and into the water. So take all the work out of it by using your winch.

Lash a block—a pulley—to the trailer frame aft. A little experimenting will show you exactly where it should go. Make up a short length of good nylon line—strong stuff—and add a hook at one end.

Now, when launching your boat, pass the nylon line through the block on the trailer frame and hook it into the boat's bow eye. Pull your winch cable down and make it fast to the other end of the line. Then apply power with the winch. The reversed pull exerted through the block will slowly haul your boat off the trailer into the water. No sweat—literally.

You shouldn't back a trailer so far into the water that wheels or bearings are submerged. There is also the risk, with light skiffs or utility craft launched from a beach, of getting stuck. Sometimes it's because of poor vision from the wheel—and poor advice from a fishing partner.

Here's a trick that you may or may not be able to use: Put a bumper hitch on the *front* of your car. When launching in tricky situations, unhook the trailer from the rear and make it fast to that hitch on the front. Now you can see what you're doing as you drive—forward—down to the water's edge on that remote beach.

Getting a boat out is sometimes a different cup of tea. Maybe tide conditions have changed, and you can't get the car right down to the water's edge—but you can roll the trailer down by hand.

If so, anchor the trailer firmly in place (chocking the wheels) and use a handy, small block and tackle to get it out of there after you've loaded the boat aboard. Now the job is easy: Winch the boat up on the trailer, then rig one of those modern, light tackles to a tree, or even to the car farther up on firm ground. Use the tackle to haul the trailer out onto better footing. If you have a power winch, you can mount it to your car bumper with a special bracket made for this purpose.

It's a simple trick but one that can spare you a lot of unnecessary agony when you must launch and reload in difficult circumstances.

Once you master a few tricks with trailers, all you tow around is fun-on-wheels. Skip the tricks and ignore basic maintenance hints, and you tow only trouble. ■■

Trailer tires are small, but they demand a lot of air pressure—50 pounds or more.

Rust is your enemy. The moment it appears, sandpaper the spot, spray on touch-up paint.

Check winch cable carefully and regularly. And stand to one side while it's under tension.

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How to Tackle Torque

Does your boat have a mind of its own? Maybe torque is making it do the twist. Here's how to handle the problem

By Jim Martenhoff

THE average skipper of a small, single-engined power boat is apt to be at something of a loss when he first encounters the mystery of torque, a force that makes his boat behave in a most peculiar fashion. Here are the power-boat behavior patterns caused by torque:

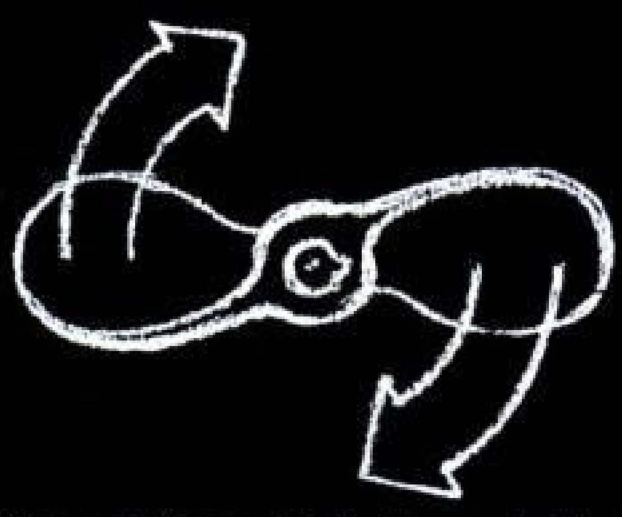
1) Hard steering. Many craft display a distressing tendency to wander off toward port.

2) List. Light hulls with potent power packages may list to port as the throttle is opened.

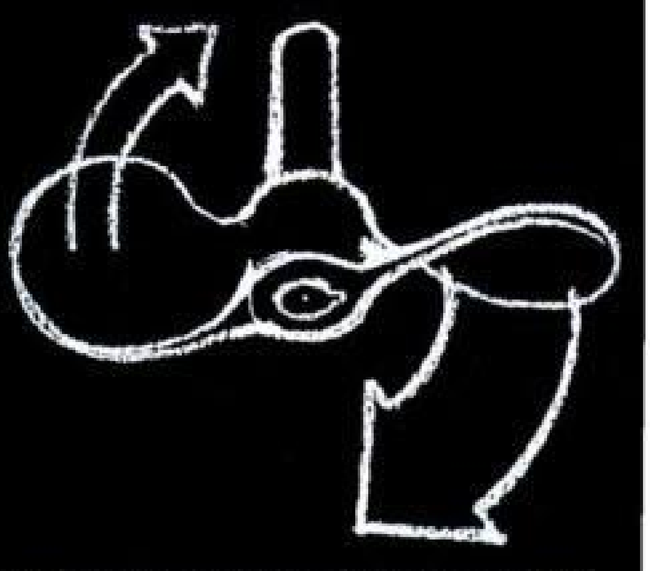
3) Variation. With some outboards and stern-drive craft, the effects of hard steering and a tendency to list may increase or decrease as the lower unit is tilted in or out.

What causes torque? It is created by the propeller. Stand behind your boat and look forward.

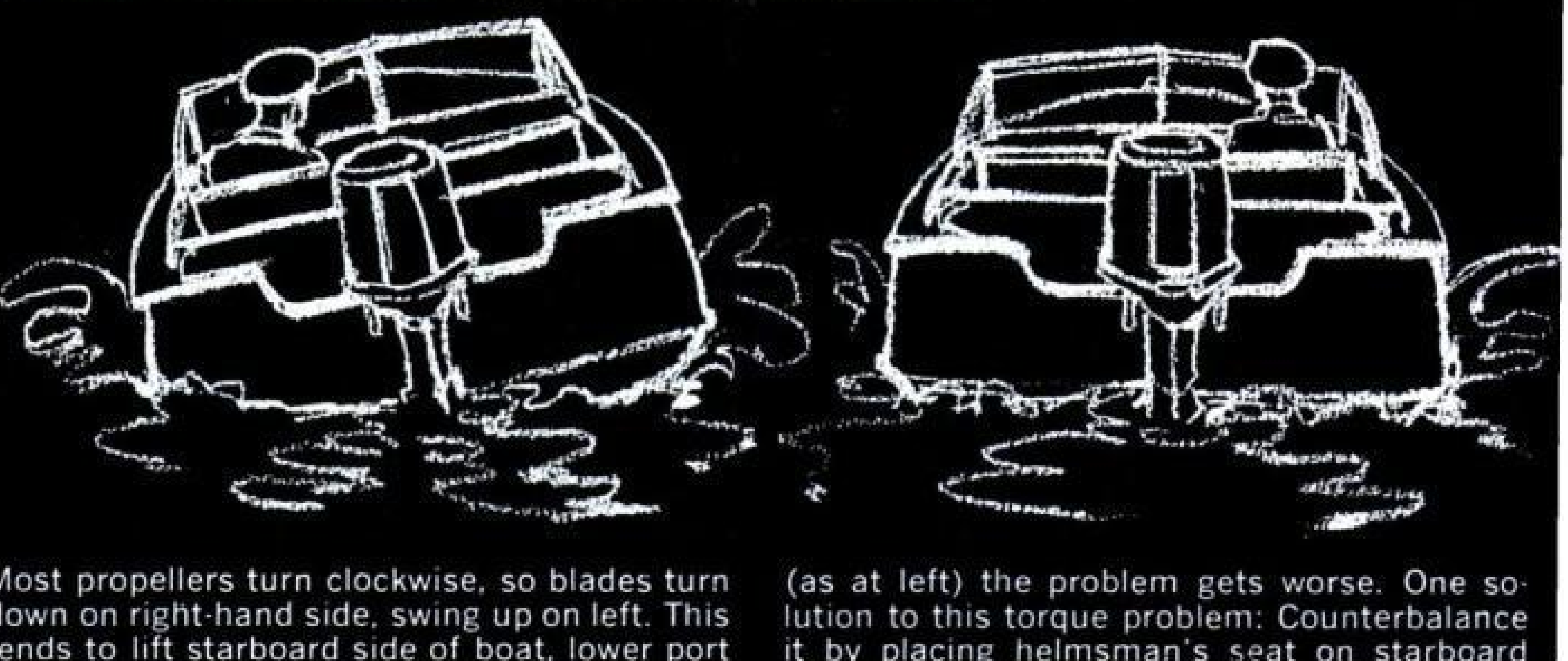
[Continued on page 173]



Viewed from straight on, both right- and left-hand prop blades look exactly equal, as they actually are. But in operation, right-hand blade **pushes down** against water; left-hand blade **pulls up.**



With downward-slanting shaft, effect is accentuated: more thrust on starboard side, less on port. This is why inboards and tilted stern drives or outboard engines tend to turn to port.



Most propellers turn clockwise, so blades turn down on right-hand side, swing up on left. This tends to lift starboard side of boat, lower port side. If helmsman's seat is also on the port side (as at left) the problem gets worse. One solution to this torque problem: Counterbalance it by placing helmsman's seat on starboard side as in drawing at right.

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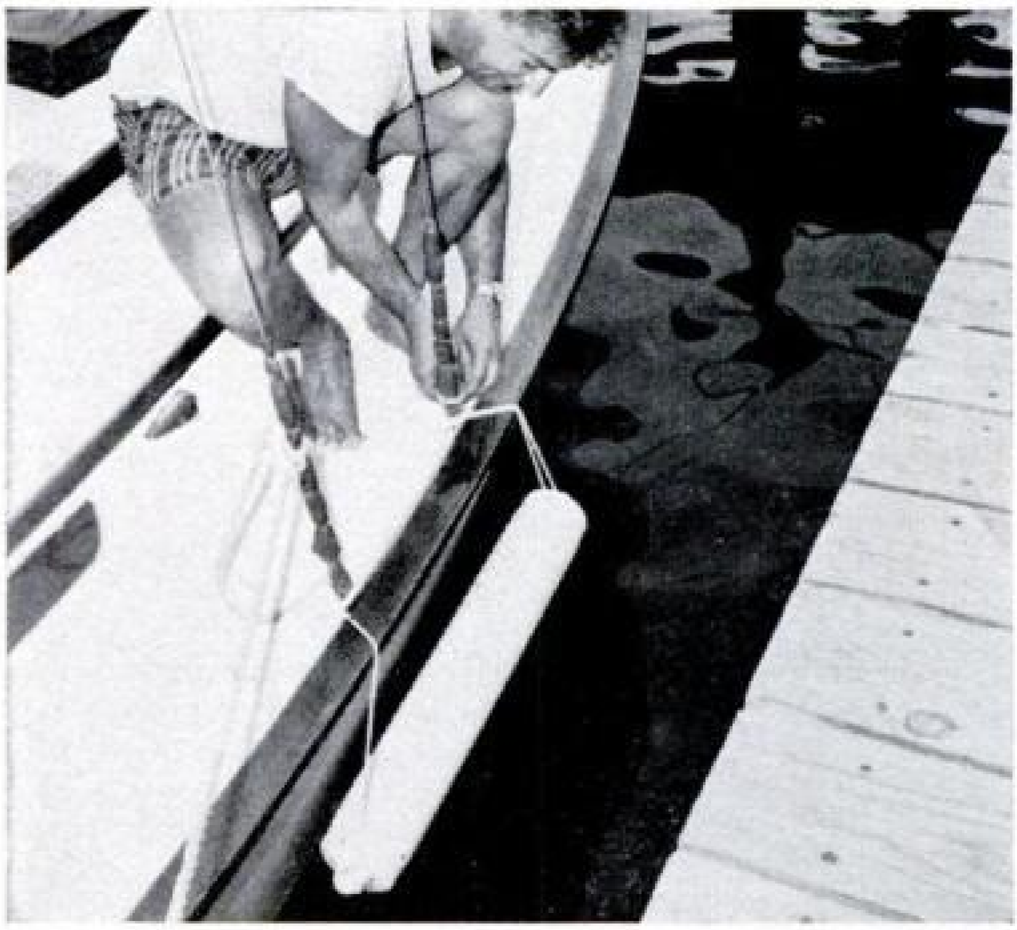
Backpack Boat Inflates for Fishing, Hunting, Fun

THIS two-man Outdoorsman packs neatly into a 15-pound package only 11″ in diameter and 27″ long. Slung on your back, it can be toted to back-country lakes or streams impossible to reach with a regular boat. It's 6′ long, 3′ 7″ wide when inflated by hand pump or CO_2 cylinder, and when afloat can carry 500 pounds. The boat alone—of tough nylon and neoprene—is $98.50; a CO_2 charger for instant inflation is $35.00. Pan Avion, 7291 N.W. 43rd St., Miami 48, Fla.



Four-foot fender can be inflated

Here's a new extra-long fender that protects greater lengths of rail and deeper topsides. Pneumatic, it can be inflated to various pressures. It's made of Du Pont's Nordel by Salisbury Rubber Products, 401 N. Morgan St., Chicago, and comes in 3′ and 4′ lengths.

Vinyl tank ring protects boat bottom

Gas tank prone to wander? A ring-shaped cushion like this, fitted snugly to the bottom of the tank, should reduce deck scars and stains; save the tank, too. $2.95. Covico, Inc., 417 E. Front St., Covina, Calif.

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How to Make a Boating

How to unswamp a small boat

1 Maneuver it alongside the rescue boat, bow on. Get swimmers aboard the rescue boat, possibly leaving one in the water to serve as a guide. Now you are ready to proceed with the unswamping operation. Be sure to balance weight in the upright boat—don't swamp it!

2 Carefully lift bow of swamped boat aboard rescue craft, taking care to have plenty of counterbalancing weight on opposite side of rescue craft.

3 Slide swamped boat completely aboard the rescue craft, so that all water can drain from it. Carefully and slowly turn it right side up.

4 Slide boat back into the water gently, taking care not to take water over the transom. Be sure there are oars, and that a painter is tied to bow.

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Rescue

By George Daniels

IT ISN'T easy to spill a modern pleasure boat, but each season a few of us bungle a little and manage to do it. Since you may be the skipper of the boat called upon to perform a rescue, it will pay you to learn a few tricks in advance to make the job as easy and safe as possible.

- Always try to approach a swamped or capsized boat from the downwind side so you can't be blown onto it. You don't want to risk pinning anyone between the boats.
- Size things up as you close in. The swamped boat may have hit a submerged rock or obstacle, so keep a sharp lookout. In an obviously hazardous area, stay clear and throw a ring buoy or life jacket to the people in the water.
- In open water, as soon as you're within talking distance, ask those in the water how they feel. If they're panicky or hysterical, keep out of arm's reach. Coast near them with power off, extend an oar or paddle to pull your boat as close as possible. If those in the water are calm and collected, tie up to the swamped boat. It's a good sea anchor, and the dunked sailors can ease their way along the line to your boat.
- If your boat's too small or too heavily

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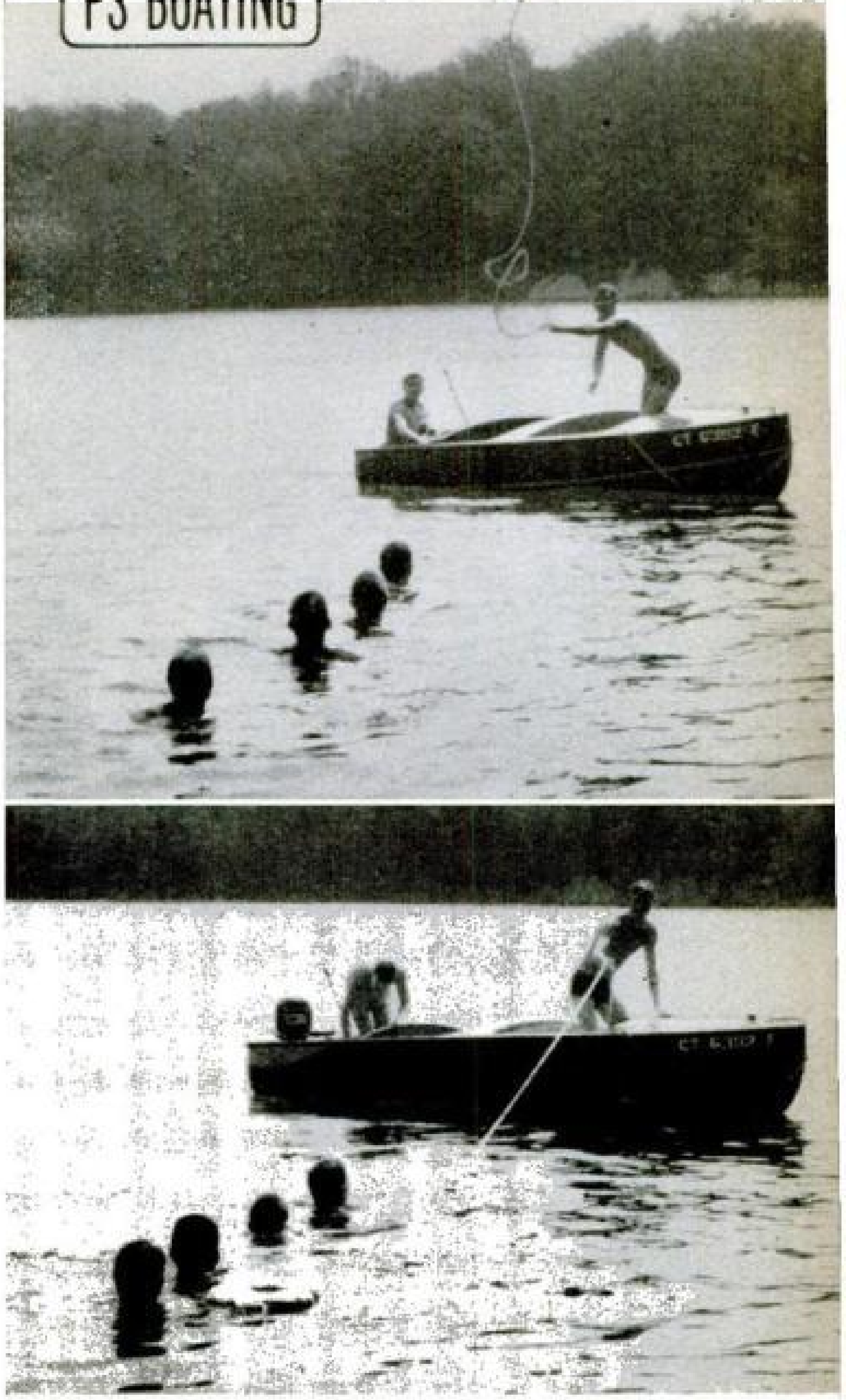
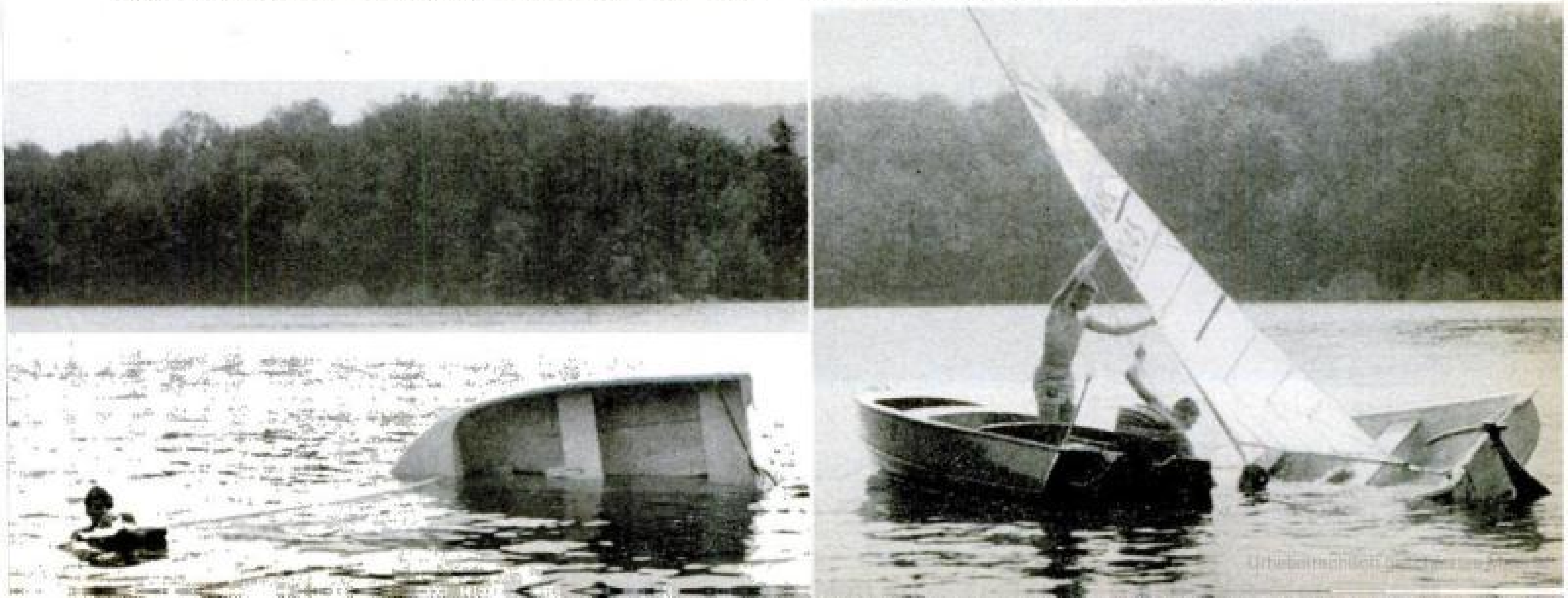
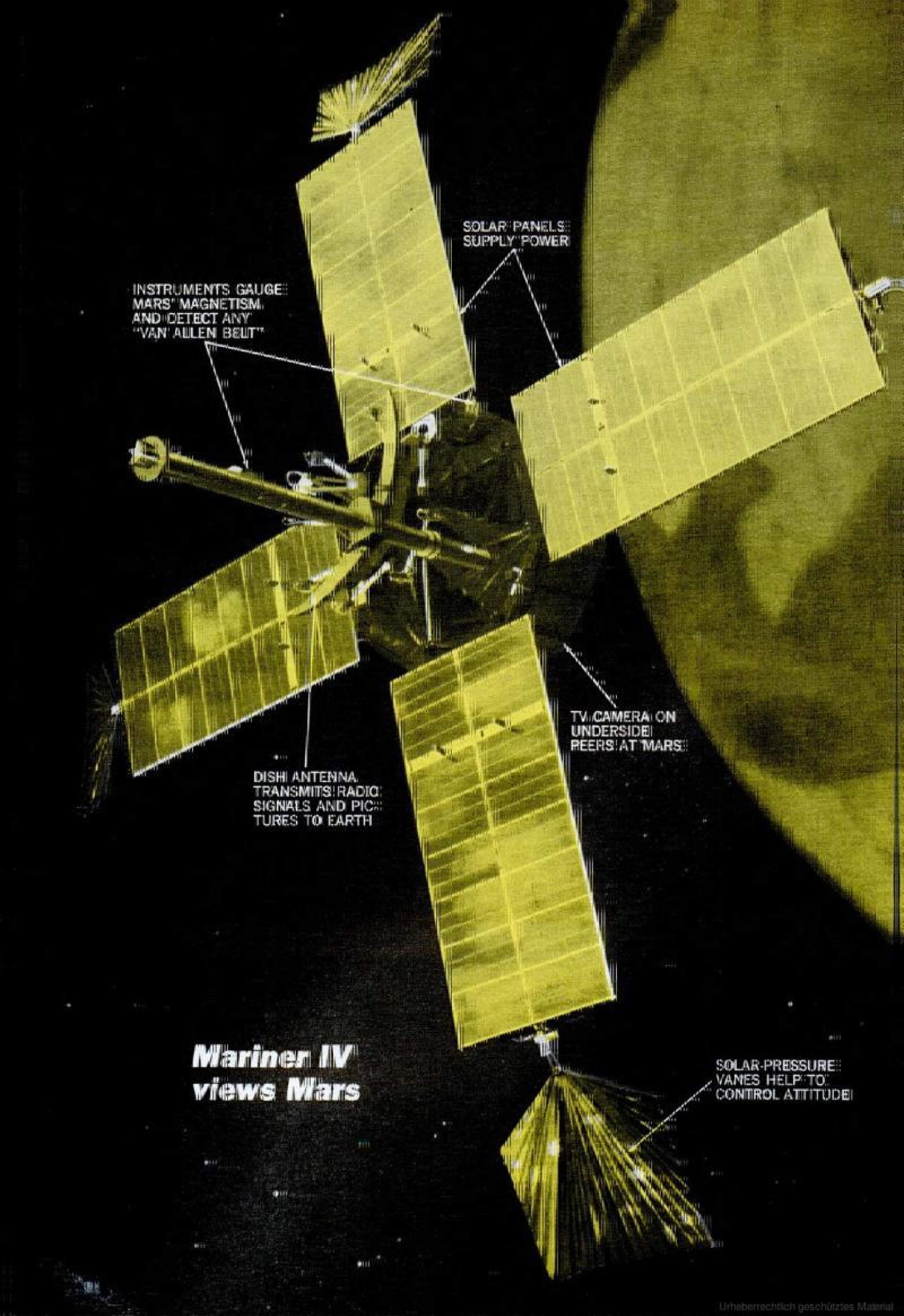


Approach swimmers from downwind side, so wind won't blow your rescue boat on top of them. Talk with them, making sure they're not panicky. Coast close with power off. Toss them a life ring or buoyant jacket attached to a light line. Then simply haul them aboard one by one, making certain you rescue weakest swimmers first. A scramble aboard might swamp your boat.

Righting a small sailboat is easy. If there is danger of mast tipping down for a complete capsize, tie a buoyant cushion to the tip end. To right a capsized boat, grasp top end of the mast and simply walk your hand down it, tipping the swamped boat upright as you go. Once the boat is upright again, bail her out, and she's ready to forgive all and sail merrily away.





Mariner IV views Mars

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Hopes ride on Mariner IV to give us our—

FIRST CLOSE-UP LOOK AT MARS

Here's how our TV-eyed spacecraft will get photos, if all goes well, when it swings past the Red Planet on July 14

By Wesley S. Griswold

WILL our Mars-bound Mariner IV spacecraft triumphantly bring us the world's first close-up photos of the mysterious Red Planet? Or will it fall prey to a heartbreaking mishap, like the radio failure that's put its Soviet rival Zond 2 out of the running?

We'll soon know. On July 14, windmill-shaped Mariner will reach Mars' orbit, just as the planet speeds by. In an action-packed 25 minutes, a tele-

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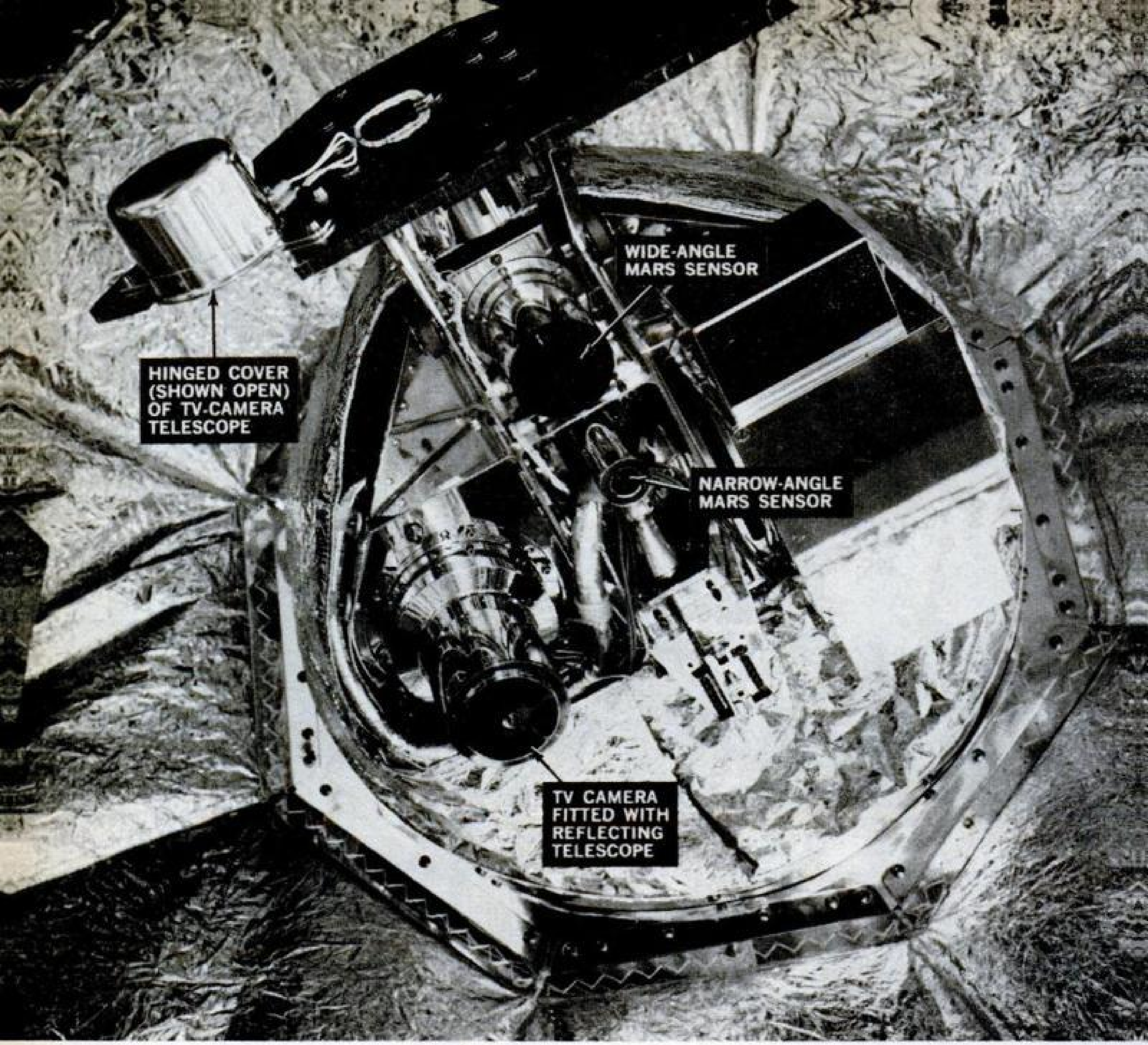
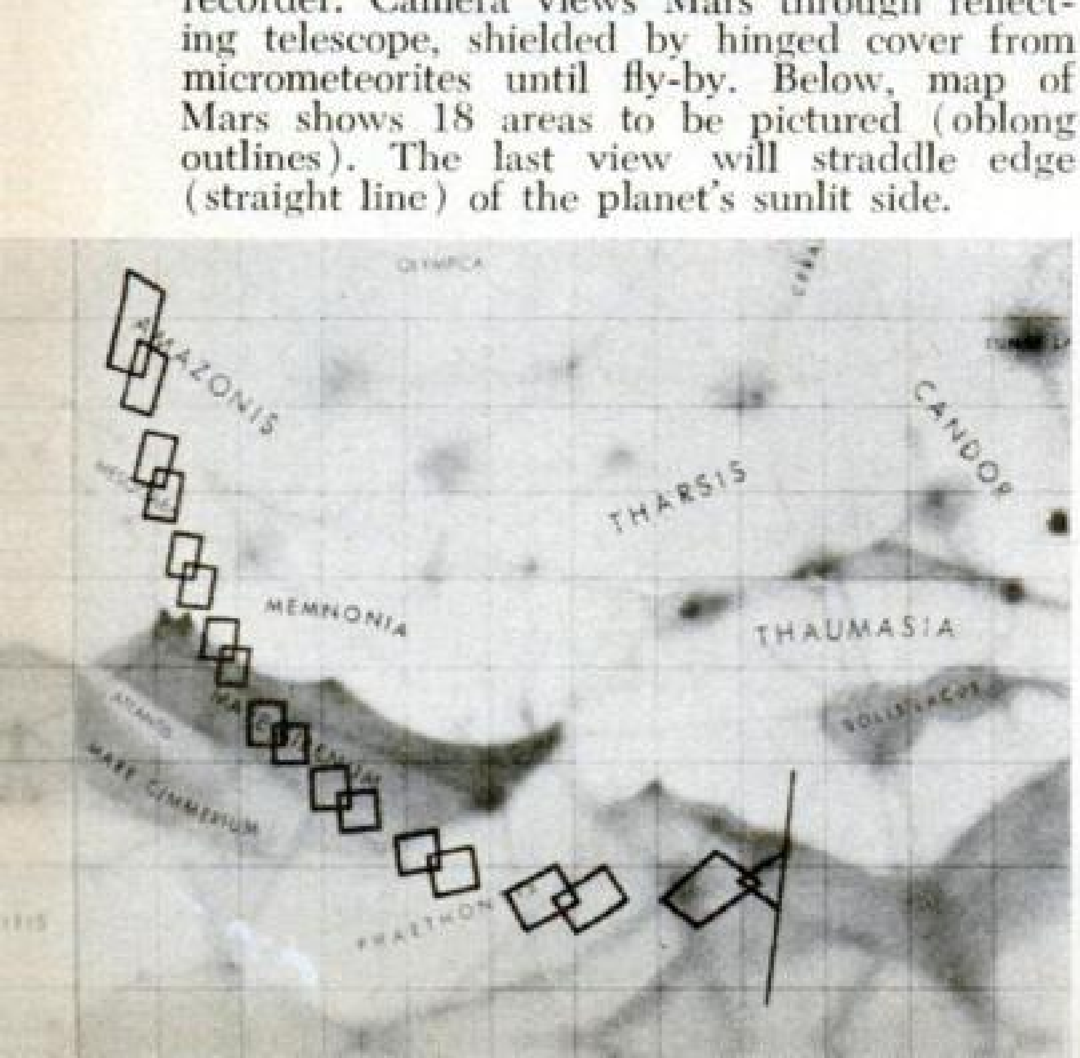


TV camera and Mars sensors ride platform that rocks to pick up planet. When wide-angle sensor sees Mars, it locks platform; when narrow-angle sensor does, it starts camera and tape recorder. Camera views Mars through reflecting telescope, shielded by hinged cover from micrometeorites until fly-by. Below, map of Mars shows 18 areas to be pictured (oblong outlines). The last view will straddle edge (straight line) of the planet's sunlit side.



scopic TV camera aboard Mariner is due to shoot 18 photos of the sunlit Martian surface, at a range of only 7,370 to 9,570 miles—compared with Mars' minimum distance from earth of 35,000,000 miles. From Mariner, Mars would look as big to the naked eye as a 12-inch globe at arm's length.

Sending the pictures. Recorded on 330 feet of continuous magnetic tape aboard Mariner, the views are to be stored for a suspenseful 13 to 15 hours—while Mars, passing between spacecraft and earth, blocks the way of Mariner's radio. Then Mariner is to begin beaming the pictures back to earth with its long-range dish-shaped antenna. Each view will take a tantalizing 8⅓ hours to transmit—and all

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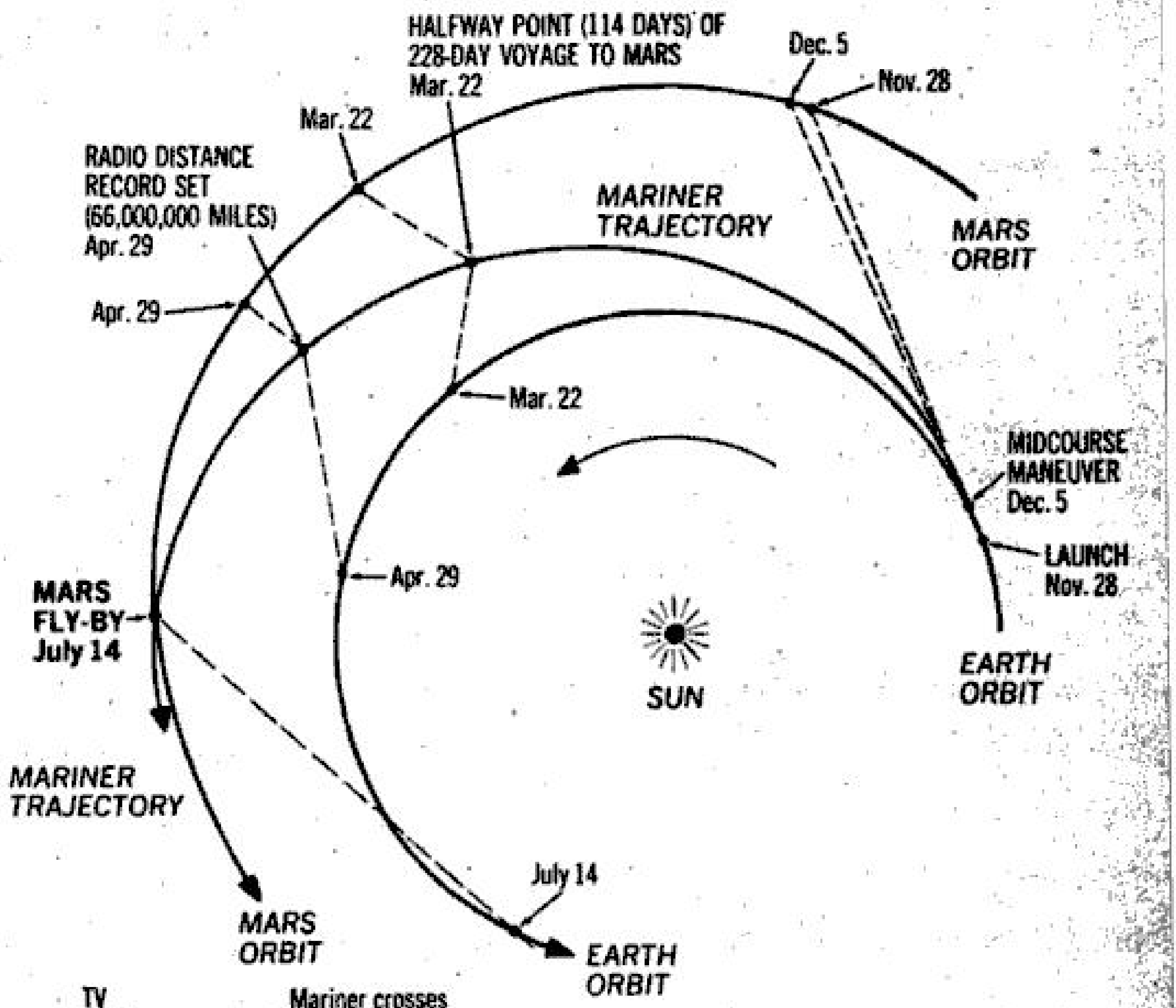
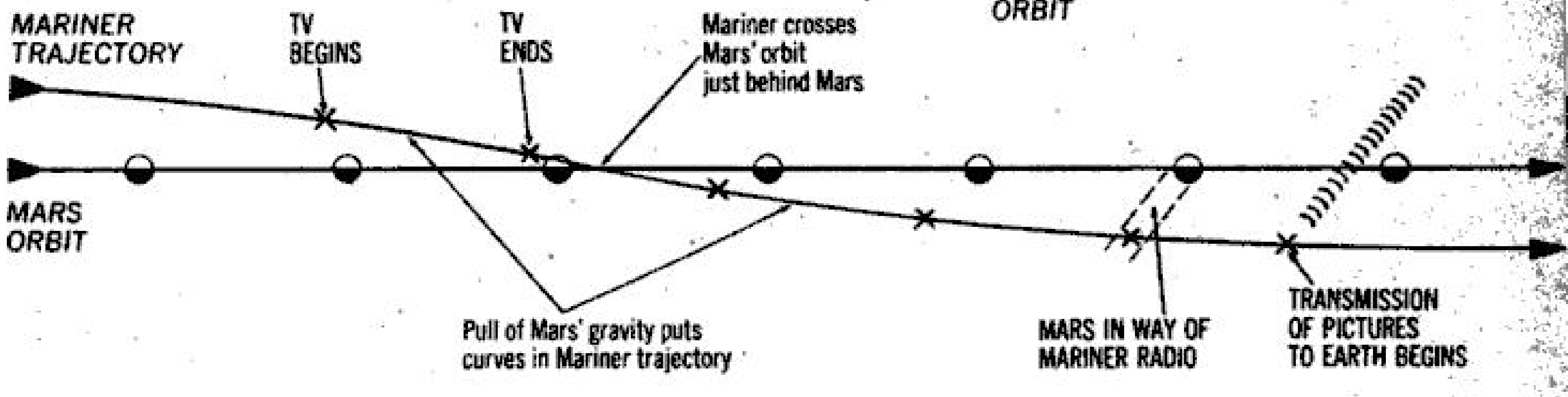
Fly-by caps 325-million-mile voyage from earth to Mars

Course of Mariner from earth to Mars (upper view), and climactic fly-by when Mariner aims camera at Mars, are shown in plan drawings. Just before Mariner cuts across Mars' orbit (lower view), planet will pass it at close range. Nearest of 18 photos will be from only 7,370 miles away. Then, from far side of Mars' orbit, and after waiting until planet is out of way, Mariner's radio will transmit the tape-stored pictures to earth. Meanwhile radio signals from Mariner, just as craft disappears behind Mars and emerges, will pass through planet's atmosphere and test its density, getting data needed to design craft to land on Mars.





18, with other data in between, more than a week. But they'll be worth waiting for.

If Mariner gets its photos, the best one —of an area 150 miles square—will clearly show Martian features as small as two miles across. That allows for the limitations of Mariner's modest 200-line TV system. Although considerably excelled in definition by standard home TV, the views will be about 100 times as good as the best Mars photos ever taken from earth. What will they reveal?

They'll be virtually the first actual photographs of Mars' famous "canals"—the wispy lines glimpsed rarely and fleetingly by earth observers, under ideal viewing conditions, and never clearly photographed before. Since the canals are believed to be 10 to 100 miles wide, some think they're belts of vegetation bordering unseen waterways. Others suggest they may be fissures. Mariner may tell.

While Mariner's TV eye could spot no individual living creatures, it may help to settle whether Mars' vast green regions are areas of living vegetation.

Sampling the seasons. Tracking data have enabled Jet Propulsion Laboratory scientists in charge of Mariner IV to pinpoint its photo targets, along a curving 4,000-mile strip from the Martian desert Amazonis southward to a mysterious blotch called Aonius Sinus. The views are to sample the Martian seasons—fall in the northern hemisphere, spring in the southern one. Overlapping pairs of pic-

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tures through blue-green and orange-red filters, respectively, are to make variously hued features stand out.

Mariner IV is to explore Mars with more than photos. Instruments will measure Mars' magnetism and detect any "Van Allen belt" like that of earth. The unknown density of Mars' rarefied atmosphere—somewhere between 1/10 and 1/100 of the earth's—will be gauged by its effect on Mariner's radio signals, just as Mariner disappears behind Mars and emerges again. Better knowledge of this density is needed to design future spacecraft to land on Mars.

And should ill luck befall Mariner IV, these are the Mars missions another U.S. spacecraft will surely undertake. ■■

The Big Question About Mars—Is There Life on It?

WHAT'S most interesting of all, about Mars, is that it now is considered the likeliest of other planets to harbor some kind of life. It's regained that distinction since 1962, when Mariner II found Venus, a former contender, too hot.

A smallish planet, Mars has about half the earth's diameter. Five-eighths of its surface looks from earth like a brick-colored desert. The rest varies in hue from blue-green to brown with the seasons, suggesting it may be covered with vegetation.

Mars has no oceans or seas. Its white polar caps, the only visible signs of water, seasonally melt so rapidly that they may be only thin surface coatings of frost. Mars' scanty atmosphere—much thinner than the earth's—consists mostly of nitrogen and carbon dioxide, with little if any oxygen (which it may once have had, but lost). The temperature at Mars' equator reaches a mild 50 degrees F. at noon but plunges to an ultrafrigid 90 below zero at night.

So inhospitable have these conditions appeared that scientists until recently have anticipated no higher forms of life on Mars than mosses and lichens. Surprising new findings by Dr. Sanford M. Siegel of the Union Carbide Research Institute, Tarrytown, N. Y., may revise that view.

Trials in Mars-simulating chambers show that common plants like beans, cucumbers, and mint will thrive in atmospheres almost devoid of oxygen. Moreover, the lack of oxygen dramatically fortifies the plants against damage by freezing. In the animal kingdom, turtles and insects likewise are found to tolerate a combination of scanty oxygen and cold, though able to survive neither alone. What these tests tell about possible Martian life is shown in an accompanying table.—*Alden P. Armagnac.*

Seeds sprout, plants thrive, in Mars-simulating chamber's atmosphere: nitrogen and carbon dioxide, with only a trace of oxygen.

A New View of Imaginable Martian Life

IN THESE REGIONS:	THERE MAY BE:
Subpolar thaw zone; dry slopes; dry flats with subsurface ice or water	Small animals, multicellular plants, microorganisms
Brackish water	Small invertebrates, molds, bacteria
Frost-collecting basins	Lichen-like forms, bacteria
Brine pools; dry flats without subsurface ice or water	Bacteria
Atmosphere	Spore-size particles

NOTES:

Martian evolution might have produced animals living in close interdependence with plants ("symbiosis") for survival, and limited in mobility except for reproduction.

No birds or flying insects. (Flying in Mars' thin air would take prohibitive effort.)

No flowering plants. (Flowering has high oxygen requirement.)

Microbes may not be grossly different from those on earth.

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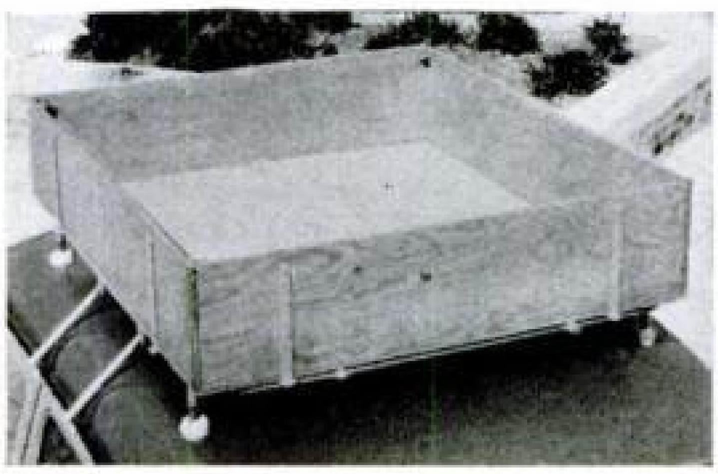
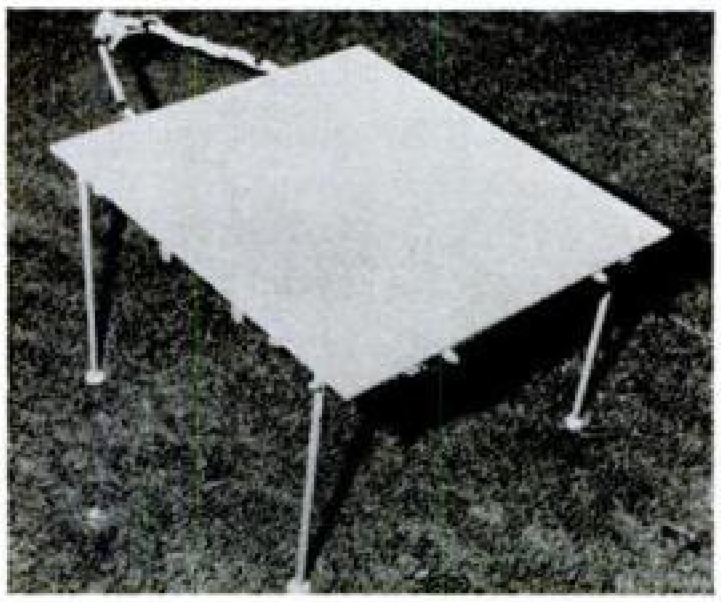
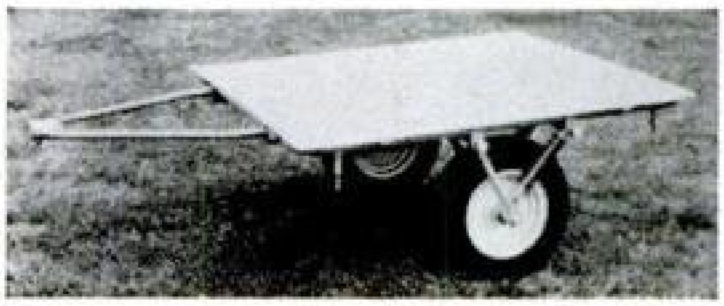
On wheels, it trails behind car . . .



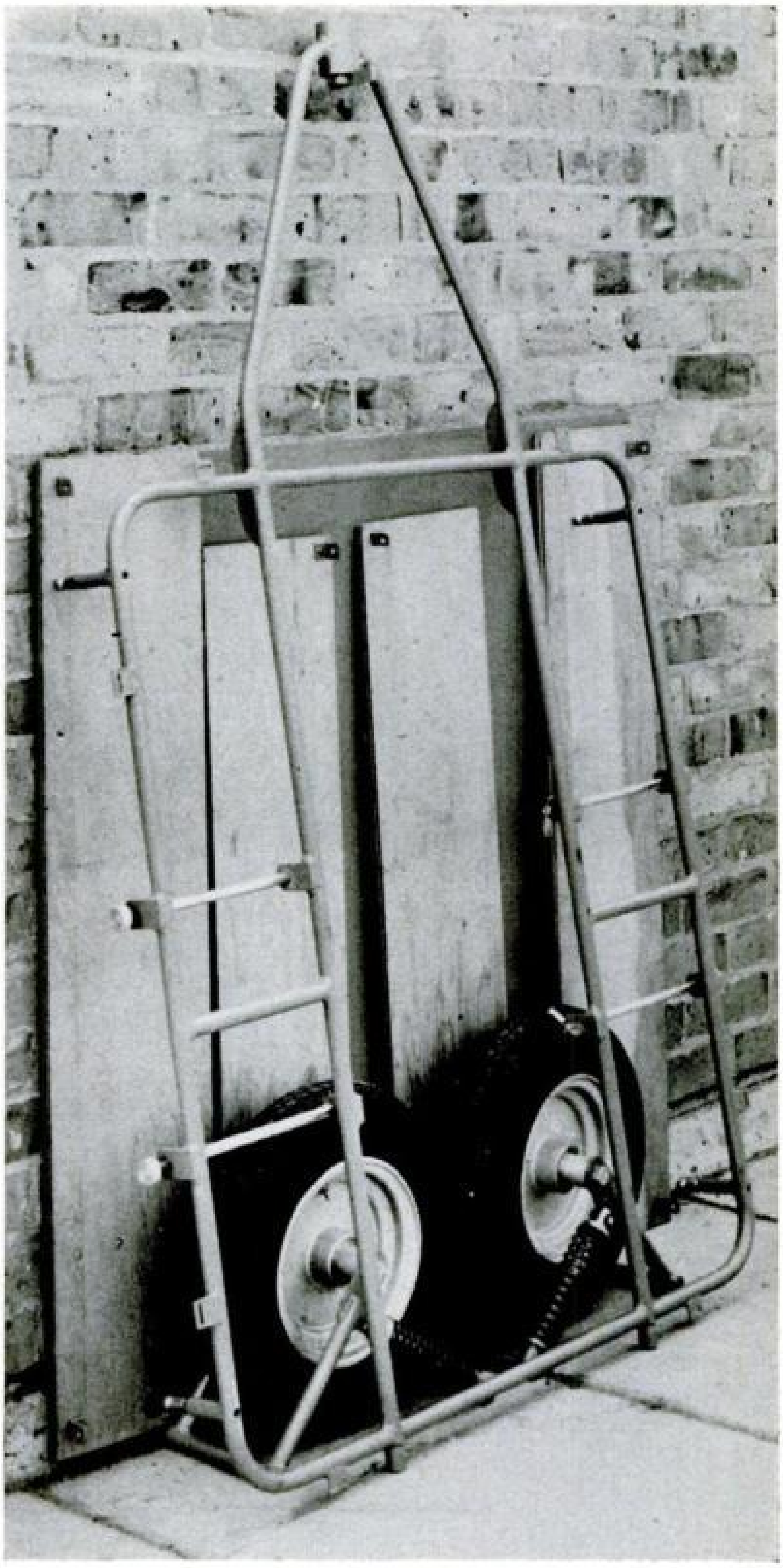
. . . wheels off, it fits car top . . .



. . . on legs, it's a picnic table . . .



. . . sideless, it does flat-top hauling . . .



. . . collapsed, it uses little space along garage wall.

This multiple-use trailer collapses for storage

This versatile little trailer can tow a 660-pound load, but doubles as a car-top carrier or a picnic table, and it can be collapsed when not in use for storage in your garage along with the car.

With its resin-bonded marine-plywood floor mounted on a welded tubular-steel chassis, the trailer is 42 inches long and 38 inches wide. It can be used either with or without 12-inch sides. It's wired for stop, tail, and license-plate lights.

Detach the wheels, put marproof rubber feet on corner studs, and you can strap the trailer to the top as a roof rack. Screw legs to the studs, and you've made it a table. The British-made Skylux trailer is sold for $190 in this country by James W. Carmichael, Clearwater, Fla.

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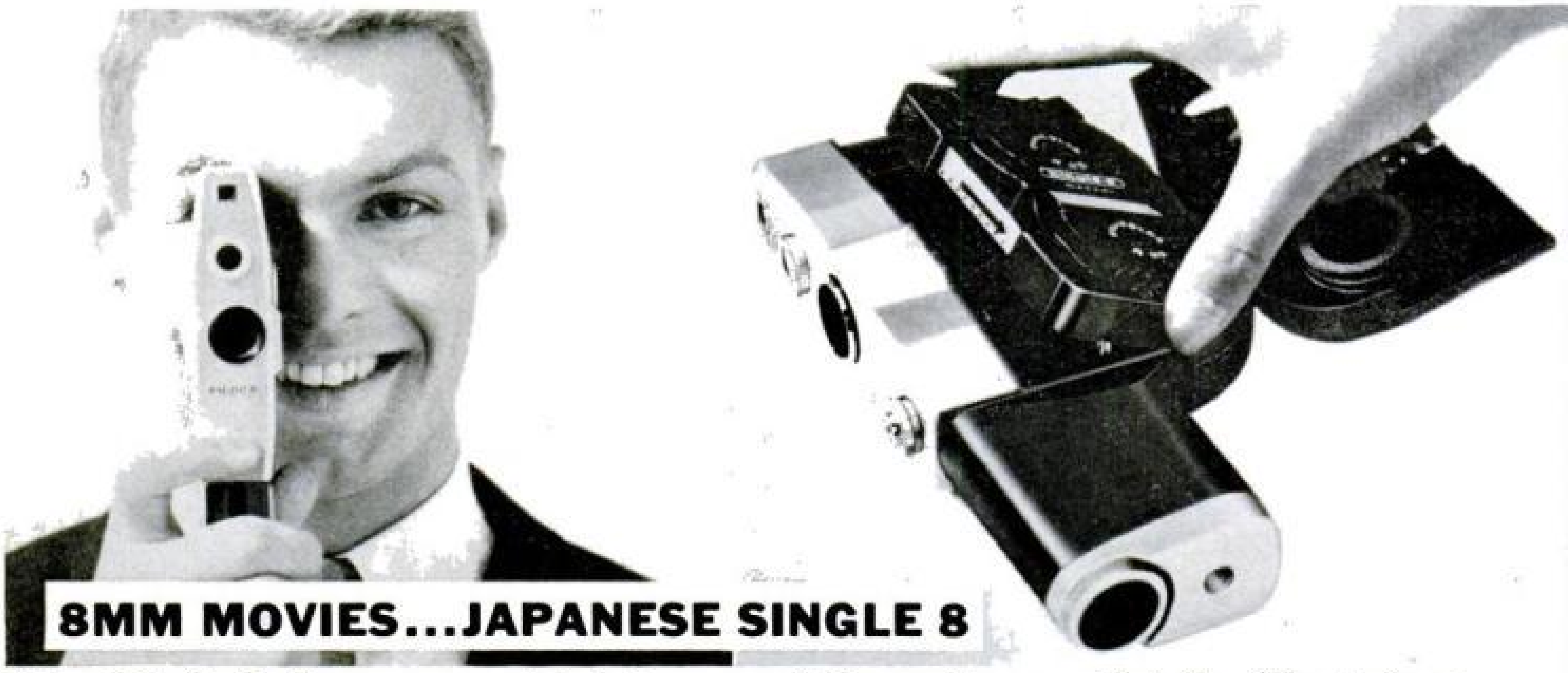
IPEX REPORT:
International Photo Exposition kicks off—

War of the



8MM MOVIES...JAPANESE SINGLE 8

Fujica P-1, Single 8 economy model, features automatic exposure control and electric drive. Lens openings are visible in viewfinder. To load, you open cover and drop in Single 8 cartridge, making sure that film slides in front of camera's pressure plate. Slot in Single 8 cartridge moves mating pin in camera to set camera automatically for speed of film.

The battles are on! Super 8 and Single 8 square off in one ring, Instamatic and Rapid in another

By Everett H. Ortner

THREE-quarters of a century ago, with roll film, a simple box camera, and a slogan—"You press the button, we do the rest"—George Eastman put a camera into every American house and made photography (and the Eastman Kodak Company) big business.

The Kodak people are still trying to live up to their founder's slogan. Two years ago, with the Instamatic still camera, they steered the photographic industry, which had been turning out ever more gadgety products, back toward filling the needs of the average man, who wants only to have to do what Eastman promised back in 1891: "press a button." This May, Kodak brought simplicity of operation to home movies with the introduction of Super 8 film in an Instamatic movie cartridge [see "Kodak's Revolution in Home Movies," June].

New Super 8 cameras are Argus 814 (left) and DeJur Electra VII. Both offer automatic exposure, *f*/1.8 zoom lens, electric drive, through-lens viewing, regular and slow motion.

While many manufacturers of equipment have rallied 'round the Kodak flag in pro-

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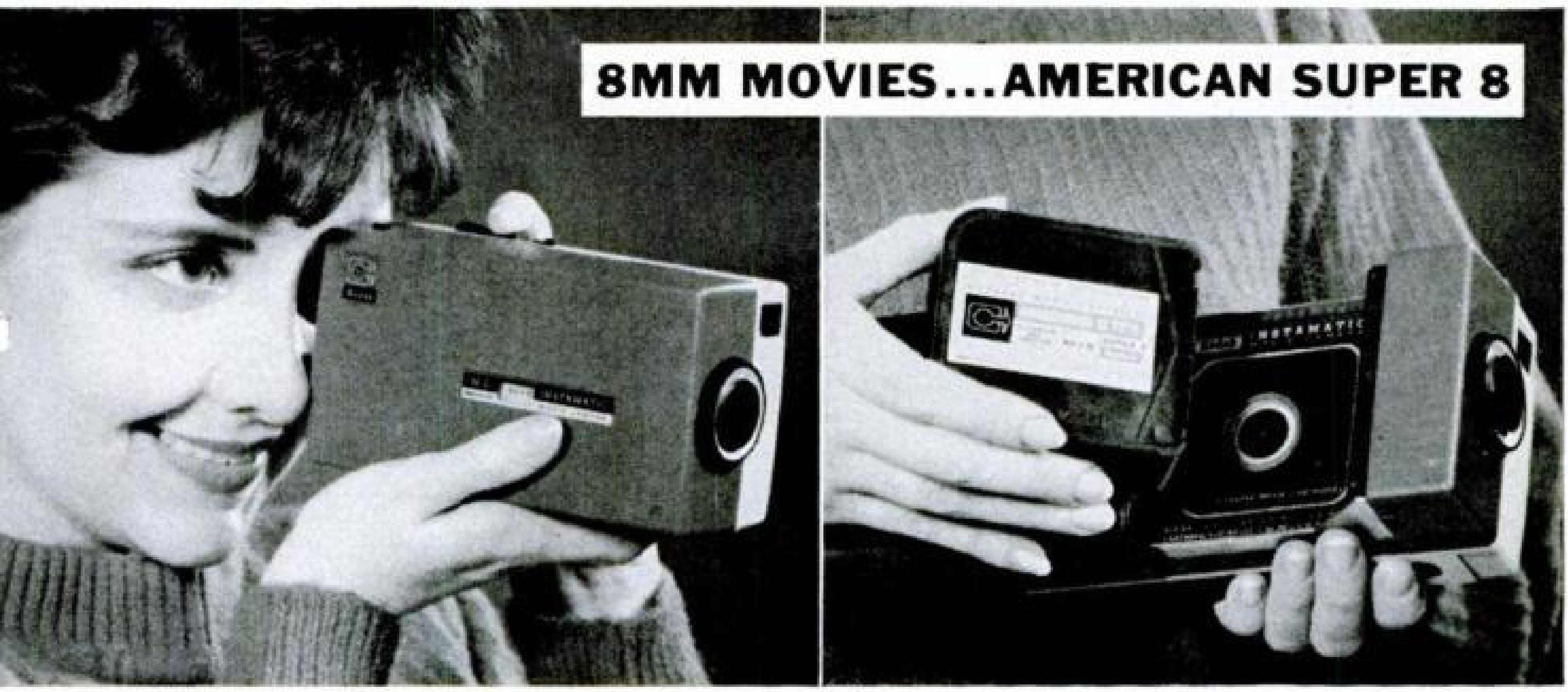
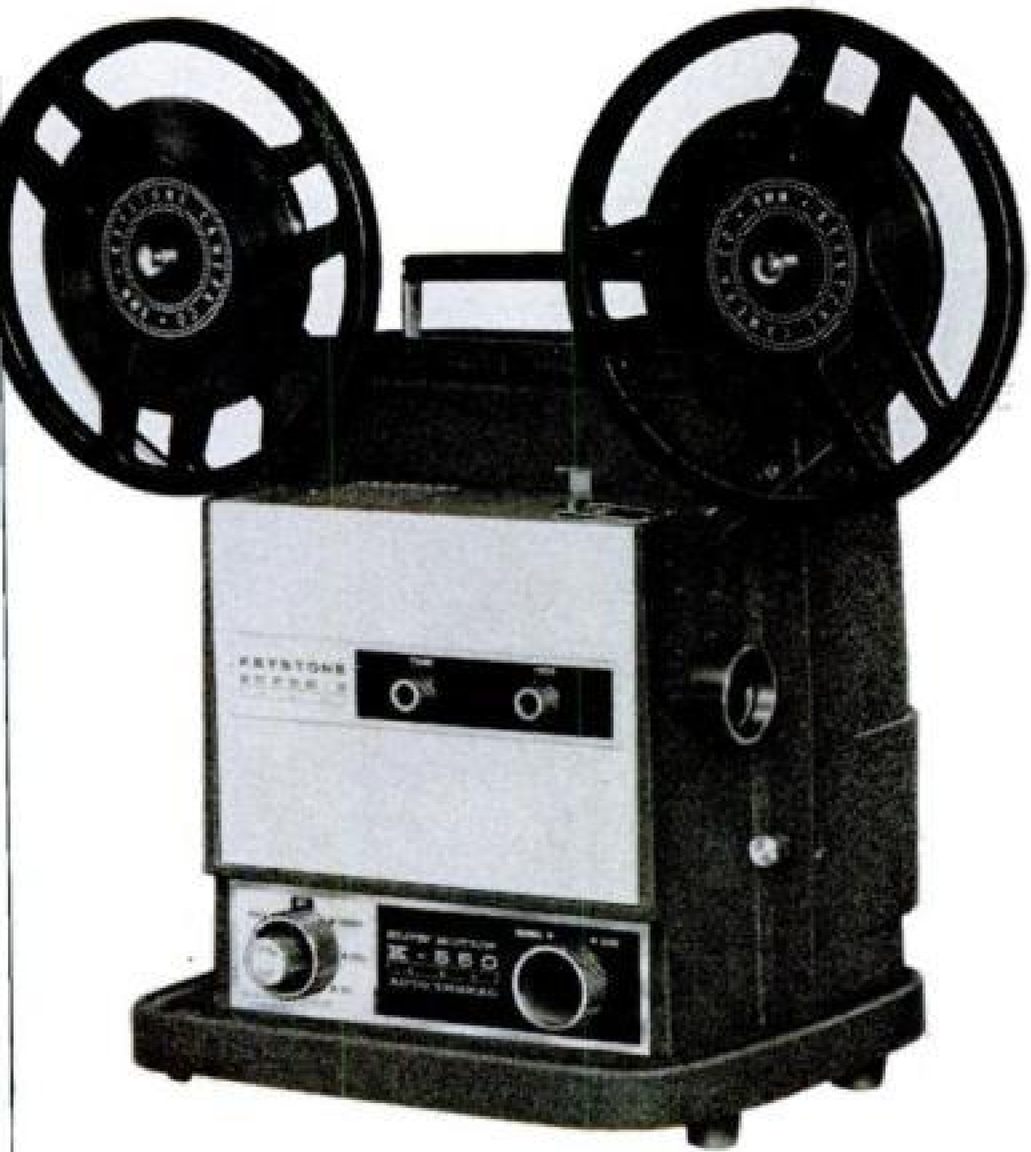
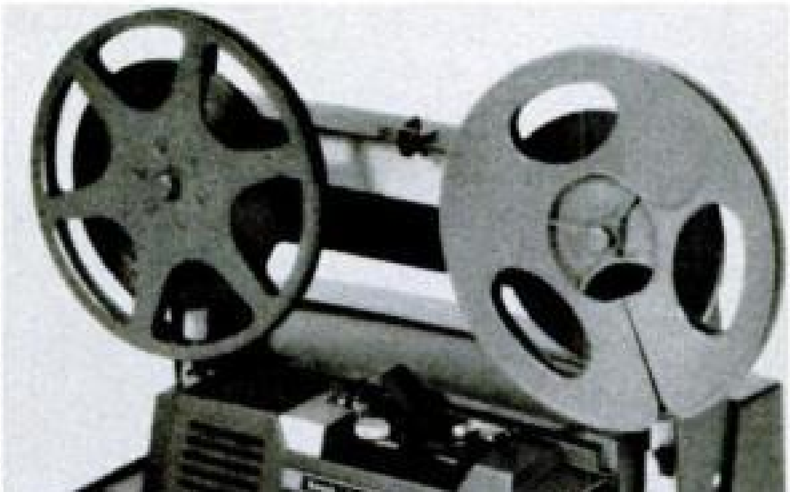
Photo Systems

8MM MOVIES...AMERICAN SUPER 8



Kodak M2, budget-priced Super 8 camera, has fixed-focus lens, manual exposure control, electric drive, built-in A filter. To load, you slide the cover back, drop in a cartridge, slide the cover forward. It costs about $50. Guide on left side of camera simplifies exposure control. Notches in Super 8 cartridge position filter, set camera for the speed rating of the film.





Super 8 projector by Kodak offers six speeds: three forward, three reverse. Cover swings up to hold reels. M70 model is shown above, M80 takes either Super 8 or standard 8mm.

Super 8 projector by Keystone offers fully automatic threading, zoom lens, one-knob control for forward, still, reverse, off, and rewind. Lamp is super-bright 150-watt.

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ducing equipment that would use Kodak's still and movie cartridges, two groups have armed themselves with competing photo systems, set up recruiting offices across the street, and declared war on the American giant.

Super 8 vs. Single 8. On the western front (Kodak's, that is), it's a movie war. At the same time that Kodak was unveiling its Super 8 system at the International Photo Exposition (IPEX) in New York, in May, the Fuji Photo Film Co. of Japan, largest manufacturer of photographic equipment in the Orient, introduced its own new movie system: Single 8.

In the two most basic respects, the systems are alike: 1) They both use the same new film format: the 50-percent-larger image, the small perforations, the same positioning of the image, the works. Regardless of whether you shoot Super 8 movies or Single 8, you end up with a film that can be projected in a Super 8 (or Single 8) projector. 2) They both use cartridges that automatically set the camera's electric-eye system for the speed of the film.

Now the differences begin: On Super 8 cartridges, the supply and take-up chambers are side by side. The film comes out of the supply chamber and moves *across* to the take-up chamber after exposure. It is a thick and small cartridge. In a Single 8 cartridge, the supply chamber is on top of the take-up chamber. The film moves *down* from one chamber to another. The result is a thin but long cartridge. Fuji has kept the length down a good deal by developing a new film base: a polyester that is two-thirds the thickness of Super 8's triacetate base.

Among the advantages that Fuji claims: 1) The film is supported by the camera's pressure plate, so that it is always exactly in the focal plane. (In Super 8, the film is held in focus by an aperture plate in the camera and a pressure pad in the cartridge.) 2) The thinner film takes up less storage space, and is said to be more stable. 3) The cartridges are re-usable.

So the war shapes up. The indications are that most Japanese camera makers will join the Fuji side, that most U.S. makers will join the Kodak side, and that some of both groups will join both sides by making cameras for both Super 8 and Single 8. A few German camera makers have begun to make Super 8 cameras; the rest are tossing coins in the air. Heads, they make Super 8; tails, they make Single 8; and if the coin lands on edge, they'll make both.

Three-in-one. However, the company that may yet cover all bets is Honeywell. Its Elmo Tri-O-Matic camera, which exists as yet only in prototype, will shoot, Honeywell claims, both Super 8 and Single 8. More, it will take standard 8mm movie film as well. The secret: separate film magazines, one for each film. You load the magazine and snap it in place on the back of the camera body.

Movie projectors present no problem in the Super 8/Single 8 war, since the film

New cameras appear: a picture-in-a-minute challenger to

Insta-Camera produces a finished black-and-white print in a minute. Film cartridge has an inner container that holds developing chemicals. Eight prints will cost about $1.75.

Graflex XL permits many combinations of lenses and backs. At left, camera with wide-angle lens, sheet-film back, sports finder; at right, with range/viewfinder and roll-film back.

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Rapid takes on Instamatic—abroad, and now in the U.S.

Rapid invasion of U.S. by 12 German camera makers, 15 Japanese, began May 1 at IPEX. Yashica above, a half-frame camera, uses Rapid cassette, has electric-eye exposure control.

Instamatic system is used by Zeiss Ikomatic F above, which takes a Kodapak cartridge. It shoots at 1/90 second outdoors, 1/30 when used with built-in flash. Cost: about $30.

formats of the two are the same. But there is still a problem: What to do about all the standard 8mm movies that lie stacked in reels in millions of closets.

Two projectors, by DeJur and Kodak, take care of the problem by handling either film. DeJur's Versatile II requires only the turn of a knob. Kodak's M80 also has a two-position knob, but requires an adapter hub for the supply spindle. Undoubtedly these two will be joined by others.

At this moment, Super 8 has one big advantage over Single 8: It's available now. Single 8 won't be in the camera stores till some time in October.

Instamatic vs. Rapid. On the eastern front, Kodak faces a still-camera war. While the German camera makers were bent over their drawing boards designing ever more advanced cameras for ever more advanced photographers, Kodak broke into the European market place with its Instamatic cameras, which anybody could use. The German public snapped them up like two-pfennig knockwursts. Result: The camera makers of West Germany put their heads together and came up with the Rapid system, which is now giving Kodak a battle in Europe. At IPEX, opening a new front, it was introduced to the U.S.

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Polaroid, a multiformat Graflex, ingenious new 35s

Beseler Topcon Auto 100 offers behind-lens CdS metering system. It is fully automatic: With camera set on "auto," lens will close down to proper *f* stop. Standard lens is 53mm *f*/2.

Canon Pellix has a unique stationary mirror—called a pellicle mirror because it both reflects and transmits light. CdS cell behind mirror measures light. Lens is 50mm *f*/1.8.

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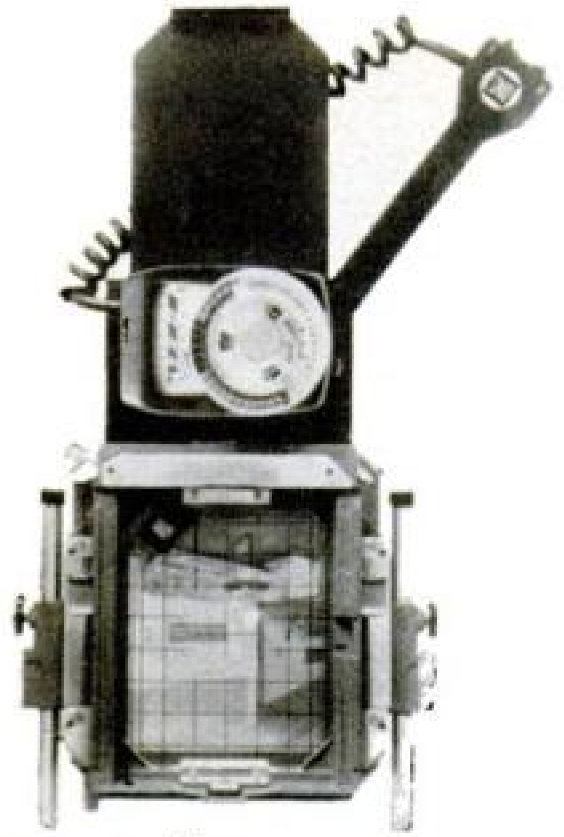


Sinarsix slips into view camera like a film holder. Moving CdS cell around on ground glass lets photographer take light reading, which shows in meter above the camera.

Camra-Corder consists of 8mm movie camera and tape recorder, coupled to make "lip sync" possible. In processing, sound is transferred from tape to magnetic stripe on film.

The SLRs are slugging it out, too

With the Instamatic system, you drop the cartridge (Kodapak) into the camera and shoot. That's all there is to it. The cartridge automatically sets the camera for film speed. Take-up and supply spools are both contained in the cartridge. When you've finished the cartridge, you just dump it out and send it off to be developed.

The Rapid system is also simple and fast to load (although not quite so simple and fast as Instamatic). The film is threaded automatically. There is no rewinding: The film feeds from one cassette into another. When the cassette is empty, you move it into the take-up position and put a fresh cassette into the supply position. The Rapid system uses standard 35mm film. It utilizes the pressure plate of the camera to hold the film in register.

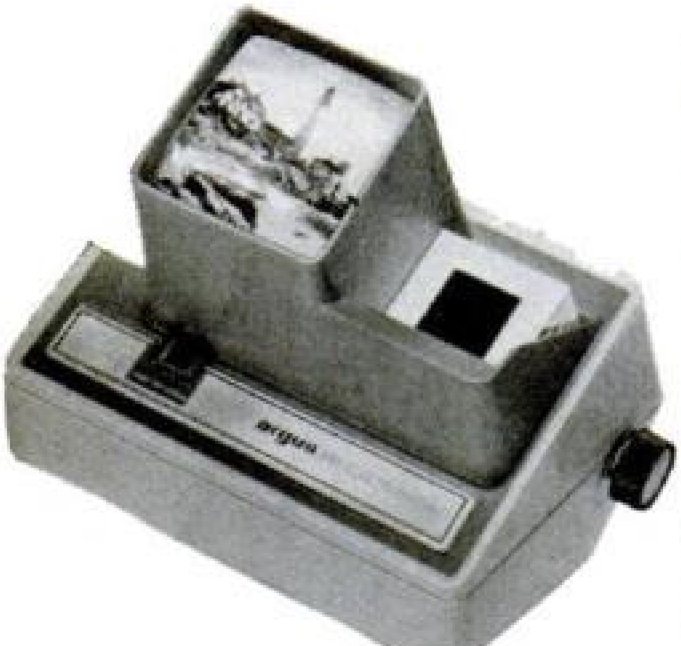
Some big German names are behind the Rapid system, among them: Adox, Agfa, Ilford, Perutz, Voigtlander, and Zeiss. Among the Japanese firms backing Rapid are: Asahi Pentax, Canon, Fuji, Mamiya, Minolta, Olympus, Petri, Ricoh, Topcon, and Yashica.

Some companies, naturally, are playing it both ways: Voigtlander, Zeiss, and Yashica, to name three, have placed bets on both systems.

At any rate, the Instamatic-Rapid war should be fun to watch—for everyone except the photo dealers, who will now have to stock still another set of films.

Fight among the SLRs. A previous war that had raged, between rangefinder cameras and single-lens-reflex cameras, has now pretty well ended in favor of the latter (a victory made official several months ago when Leica, leader of the rangefinder forces, capitulated by introducing, at last, its Leicaflex). But although the war is over, the victors are

[Continued on page 160]



Electromatic viewer by Argus passes stack of 36 slides through automatically at five-second intervals. "Hold" switch stops machine to permit longer viewing. It runs off house current.

Sekonic L-164 CdS underwater exposure meter is designed to work down to 300 feet in the ocean depths. Good for rainy days, too. It's used like any meter, with controls on the outside.

Pen Projector II, made by Olympus, has a separate blower unit. The two units "plug in" together, travel in separate carrying cases, weigh two pounds each.

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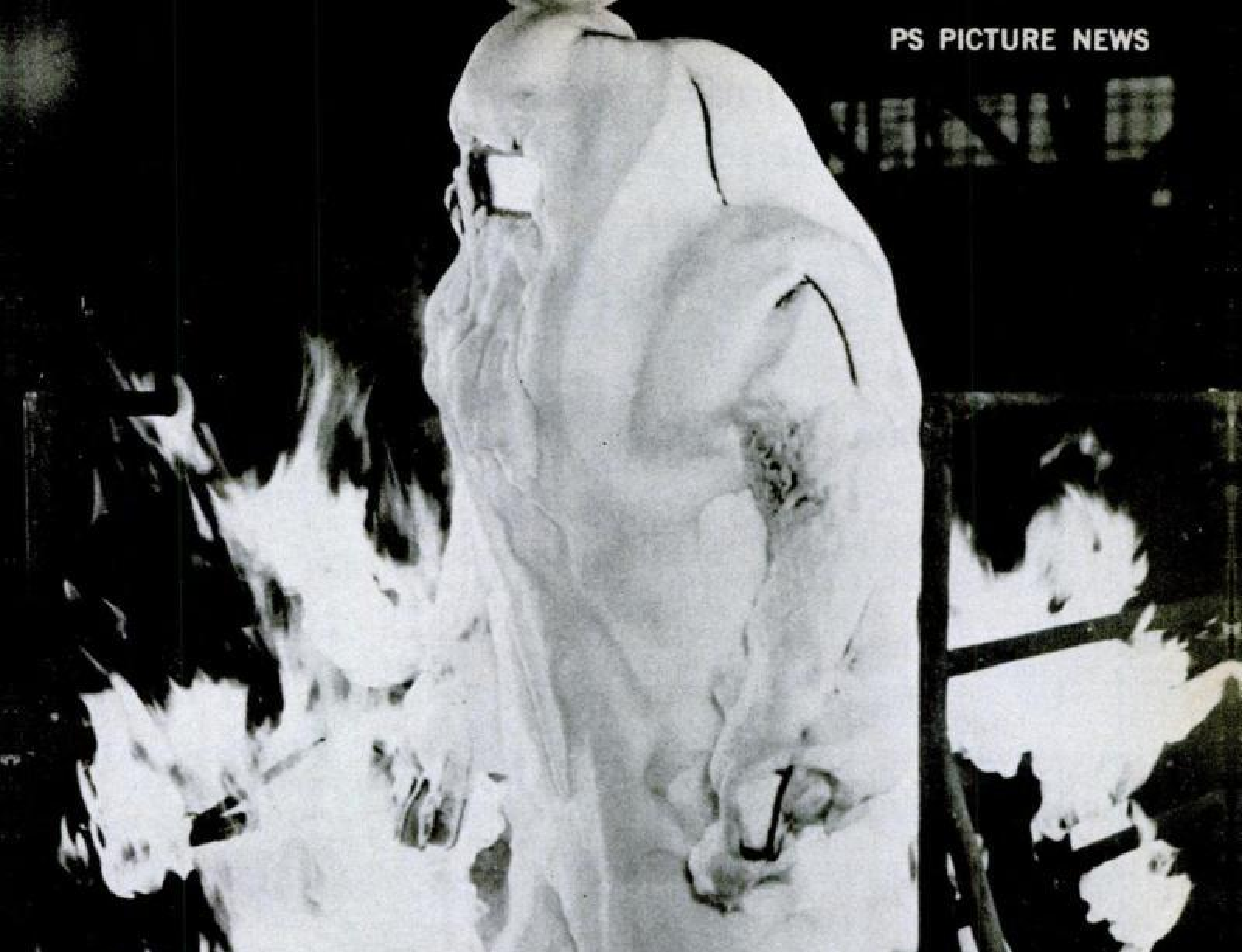

Melting "abominable snowman" walks through flames

Looking like some weird Himalayan creature, this is a fire fighter enveloped in detergent. As the foam evaporates, it keeps him cool under 2,000 degrees of heat for up to 15 minutes—enough for a rescue at a plane crash or other fire. Union Carbide developed the system, which is connected by hose to ordinary coveralls.

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To lick vapor lock, percolation, and other hot-weather engine ailments—

Know Your Carburetor

By Frank L. Greenwald

WHEN it gets sizzling hot outside, under your car's hood the engine starts living in temperatures that may hit 180 degrees or more. Gasoline evaporates from your carburetor; vapor lock stops fuel flow at many places. Your engine can even be flooded by percolation. Knowing your carburetor and fuel system will help you to avoid—or cure—these troubles.

Most modern V-8 engines have four-barrel carburetors that look wondrously complex but are, as a rule, amazingly trouble-free. What happens in the float chamber determines how the carb will work in the heat.

The float system. A hollow brass float pivoted at one end has an arm bearing against the needle valve. Fuel under pressure from the pump enters past the needle valve to the carburetor bowl whenever the fuel level drops. While the engine is running, fuel is constantly admitted in amounts depending on engine demands. The fuel level is maintained within close limits, since a variation in level would vary the fuel-delivery rate at the nozzle.

Problems: Minute particles of dirt can prevent the needle from seating and cause a carburetor to flood—the term used when the bowl overflows and gasoline runs out of the main nozzle. When idling in hot weather, the engine cannot tolerate any extra gasoline in the fuel-air mixture. If the bowl overflows, the flooded engine will stall.

Most cars today have an extremely fine filter at the carburetor fuel inlet to keep out foreign particles large enough to cause leakage past the needle-valve seat.

Where no final filtration is provided, in-

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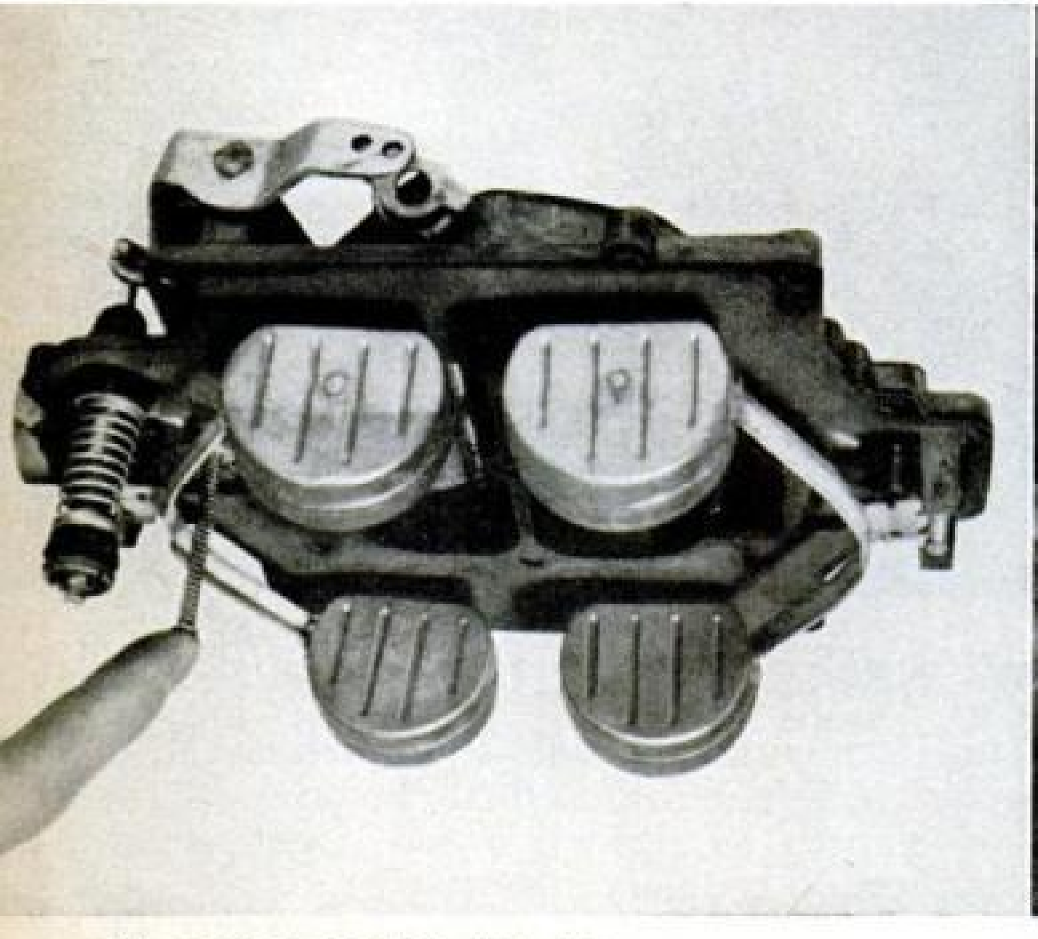
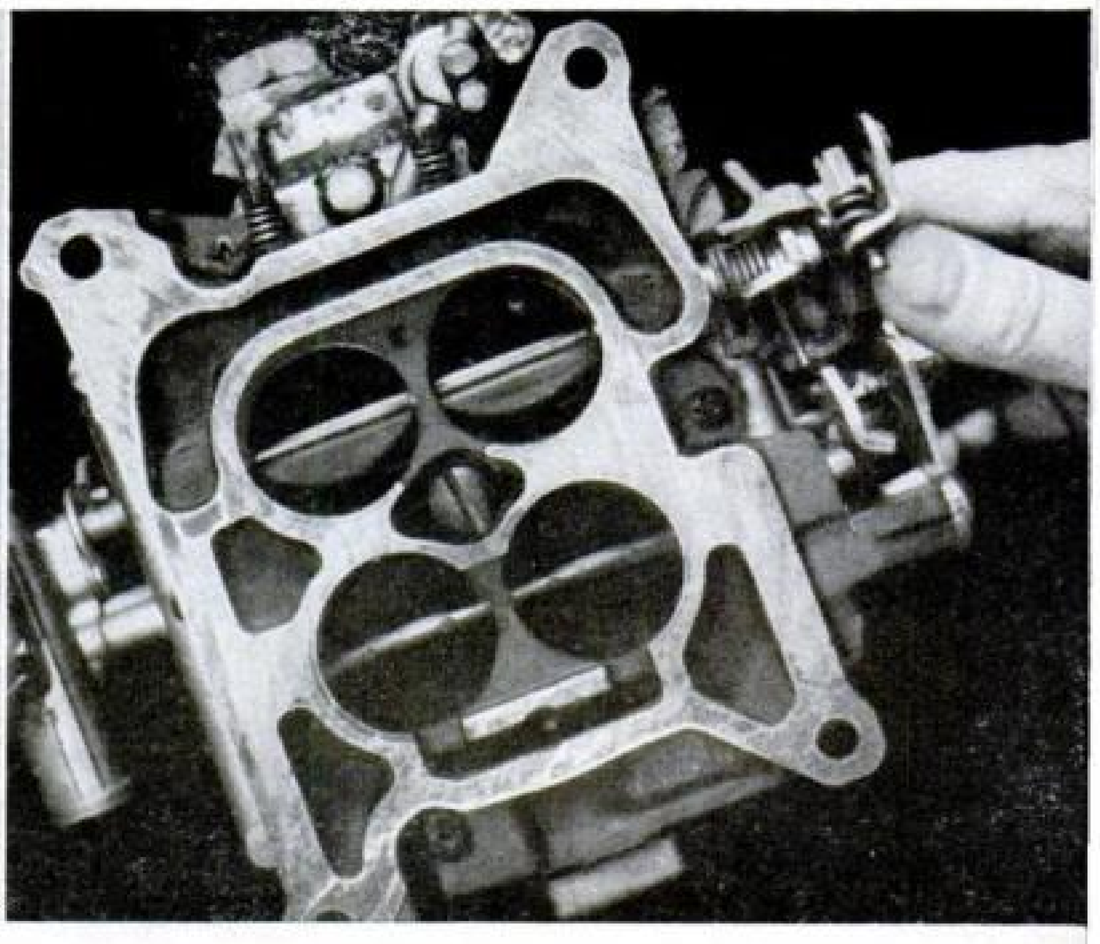


Quad carburetor bowl-cover and air-horn assembly shows separate float for each barrel (cutaway on facing page shows latest single-float design). Finger indicates power piston rod and accelerato. pump plunger which feeds only the two primary barrels for low-speed driving.



Throttle valves of standard quad carb show how linkage opens primary butterfly valves (upper pair) nearly all the way before secondaries (lower pair) s.art to open. Thus for normal driving you have two-barrel economy with gas-gobbling secondaries available for power.

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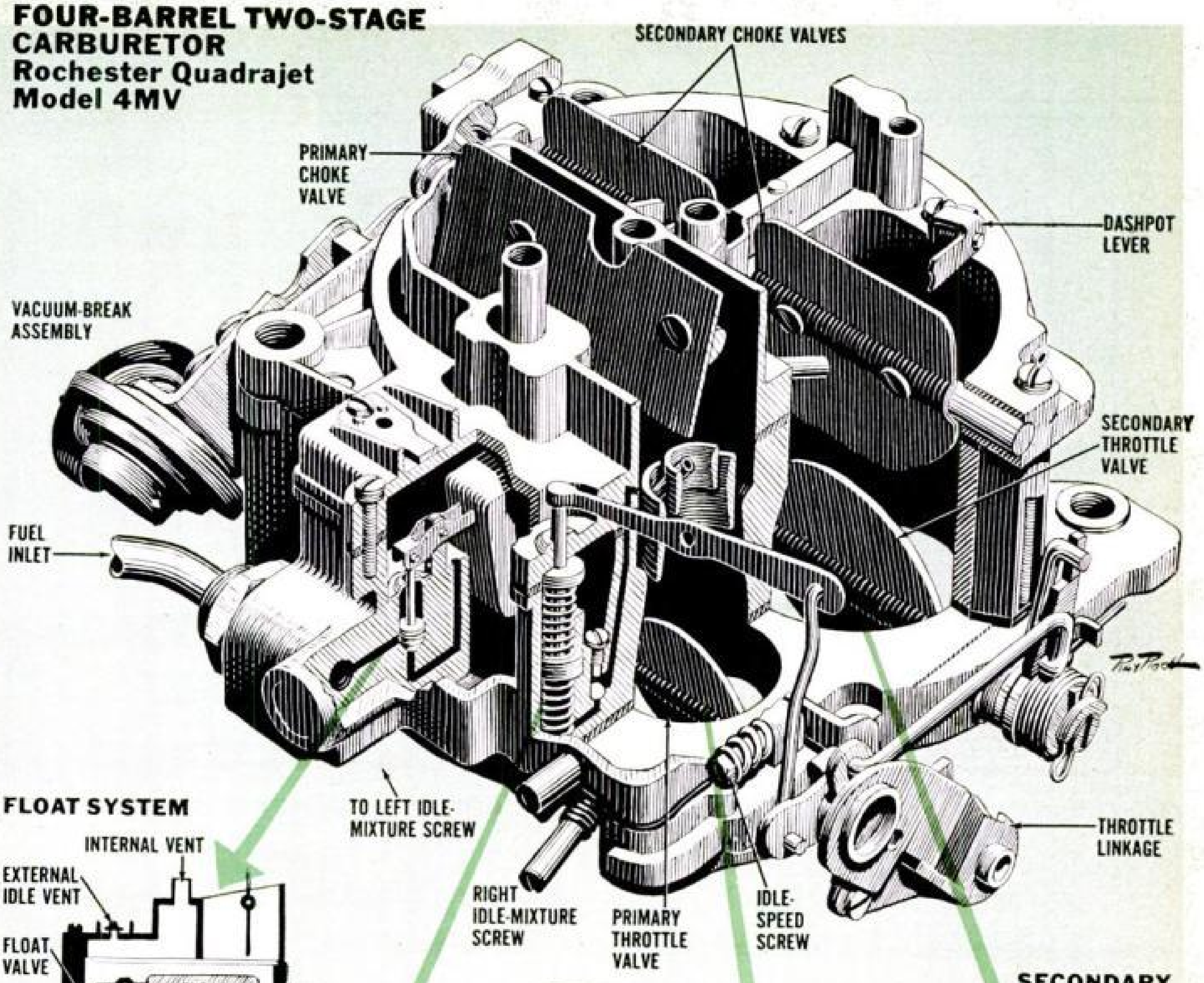
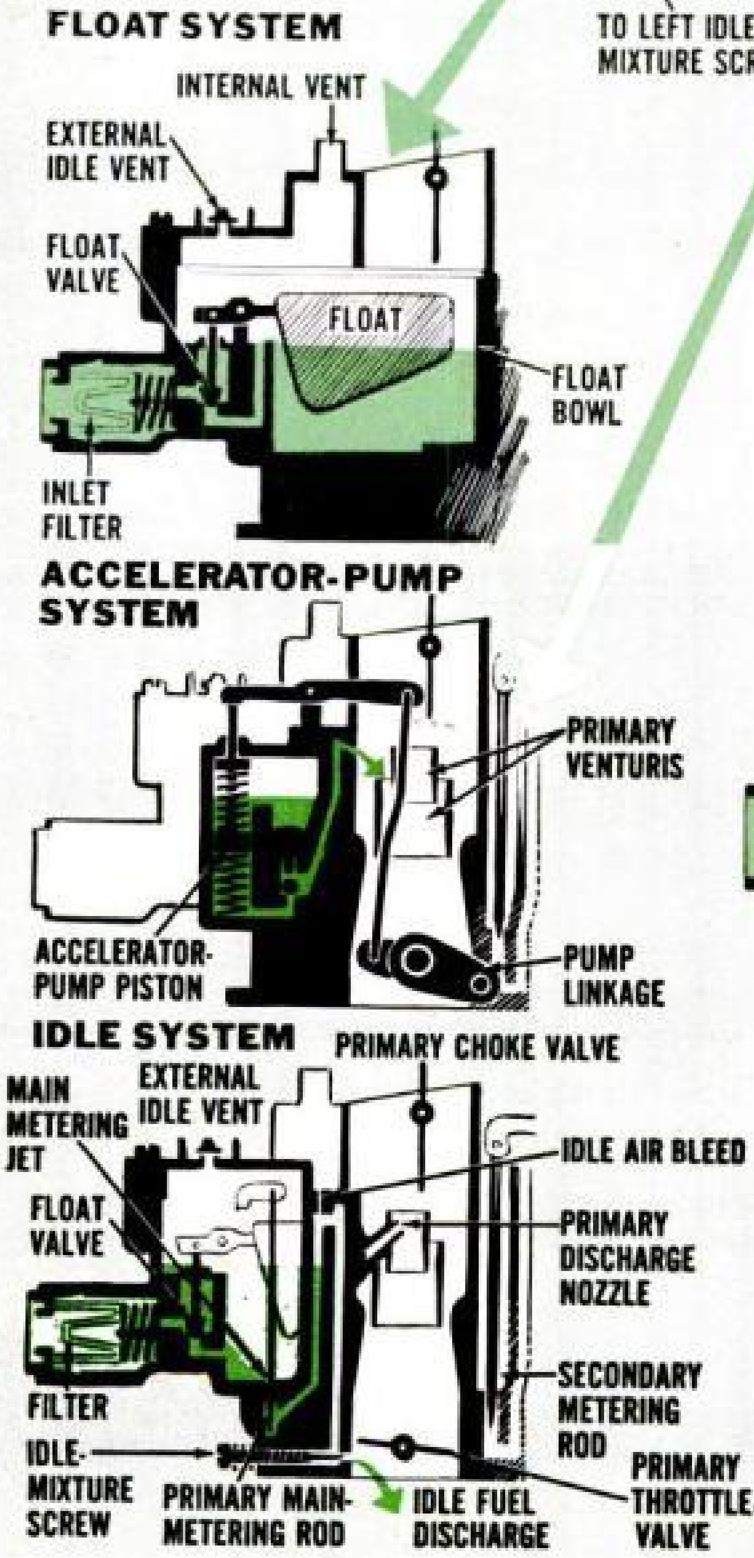
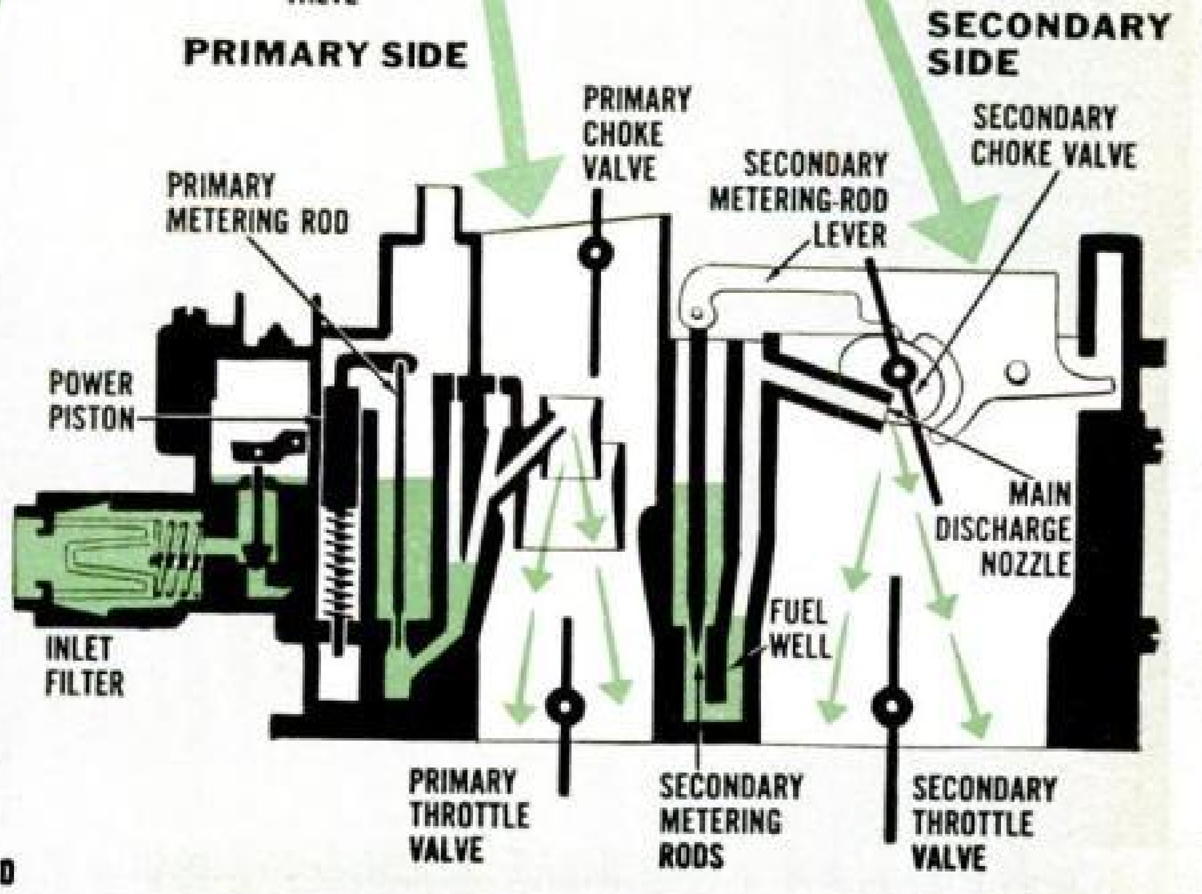
FOUR-BARREL TWO-STAGE CARBURETOR
Rochester Quadrajet Model 4MV







How four-barrel carb works: Basically, all it does is mix fuel with air so the engine gets correct mixture at all engine speeds. Four barrels permit efficient low-speed design using only two smaller barrels—while still having throat capacity in larger secondary barrels so high-rev, large-displacement V-8s get air and fuel needed when you call for wide-open power.

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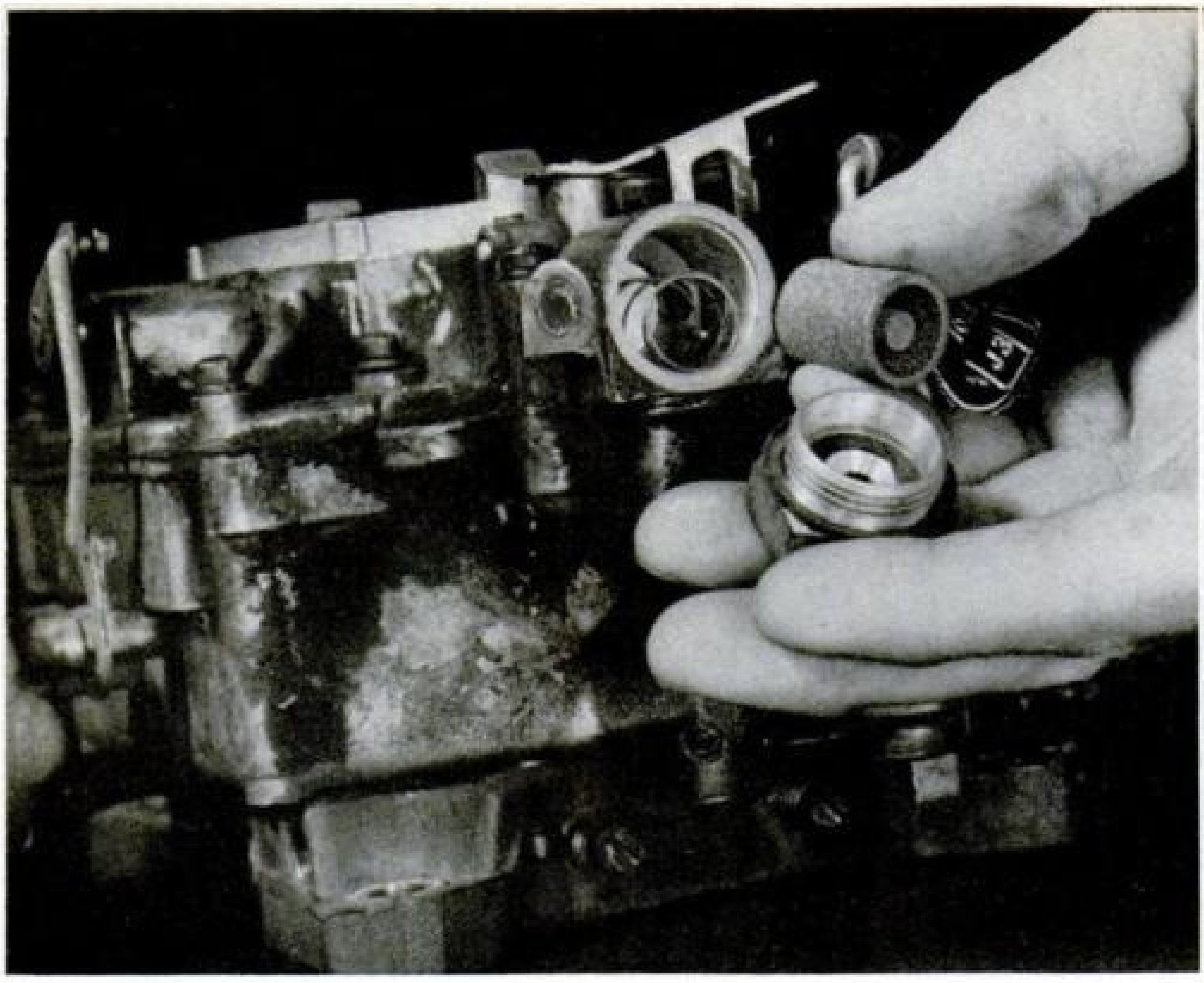

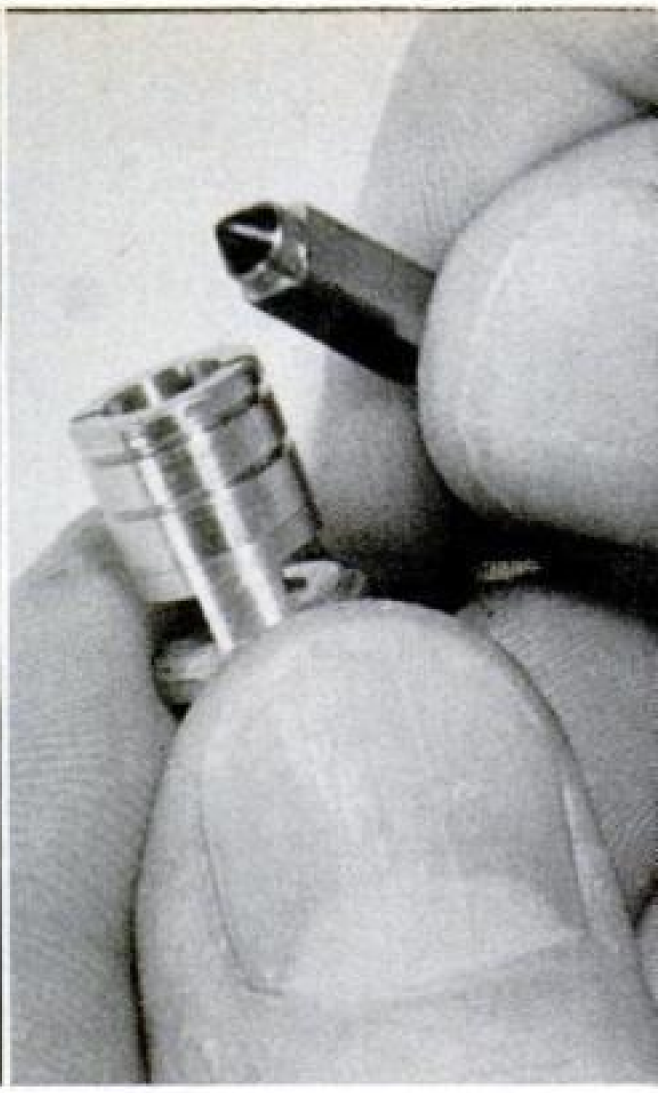

Inlet filter of sintered bronze keeps gasoline free of abrasive impurities that could wear jets, valves, and other delicate parts, or clog narrow passages. If engine falters at high speed or when accelerating, but runs well at low speeds, probably this filter is clogging up and needs replacing. On needle-valve-and-seat assembly pictured above, you can see soft plastic tip on needle that enables it to form a seal even when there are impurities in the fuel. The needle valves in the newer carbs (like that in cutaway drawing) have no separate replacement seat.

stalling a needle with rubber-like material on its seat may stop dirt-caused flooding.

The idle system. When you let up on the accelerator to reduce engine speed, the air velocity through the carburetor barrel is too low to move any fuel through the main nozzle. However, high vacuum on the intake-manifold side of the throttle automatically activates the idle system.

Air drawn in through the main venturi picks up fuel from the idling jet, and this rich mixture is drawn down a passage to the idle-adjusting screw. Here the mix passes through a small port in the carburetor throat just below the throttle valve. After blending with the air coming past the edge of the throttle valve, the idle mixture is pulled into the cylinders.

Adjustment: Dirt and gum gradually accumulate in the idle-system air passages and necessitate occasional idle-mixture adjustment. Before attempting *any* carburetor adjustments, be sure the engine is warmed up to operating temperature and the parking brake is set. On cars with automatic transmissions, place the selector lever in Drive.

Single-barrel carburetors are fairly simple to adjust. The idle-mixture adjusting screw is *slowly* turned clockwise until the engine begins to falter (run rough). The screw is then backed out ¼ to ½ turn. If the engine idles too fast, back off the idle-speed adjusting screw and readjust the idle mixture.

Dual and quad carburetors are adjusted differently since each (primary) barrel feeds half of the cylinders. With engine *stopped*, turn each adjusting screw clockwise carefully until it seats; then back out each adjusting screw the same amount—two turns is usually about right. With engine running, turn in both screws equally and alternately until the engine falters; then back out each screw ¼ to ½ turn.

A word about idle-range troubles. When one adjusting screw can be turned in or out and not affect engine speed, the idle passages leading to this screw are clogged with carbon or its idle jet is blocked. This condition can sometimes be remedied by running the engine at about 2,000 r.p.m. and closing off the air intake with the palm of your hand momentarily. The high vacuum exerted against the jets and passages will often displace a troublesome dirt particle.

The main metering system. The main nozzle projects into the air stream in the carburetor throat, its open end above the fuel level just past the smallest part of the

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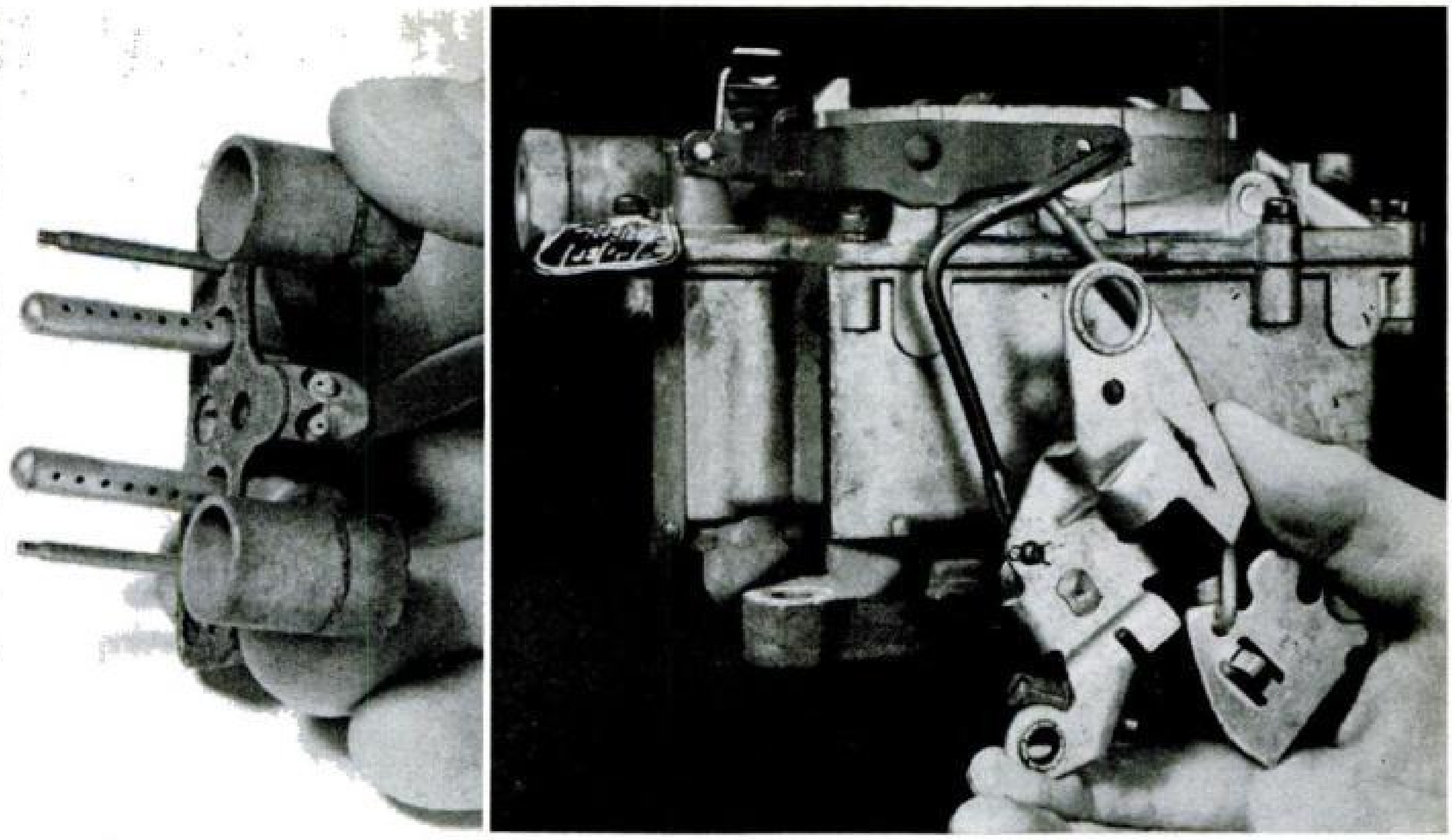

Primary cluster from a Rochester carburetor (left), contains main nozzles, idle tubes, fuel passages, and small (secondary) venturi. Gasket shrinkage can cause fuel and air leakage, cured by cleaning and regasketing. Modern carbs should need new parts rarely. Accelerator-pump linkage at right (painted black to show up) connects throttle linkage to the pump piston rod. When you floor the accelerator, this piston squirts a shot of raw gas into the venturi to give the richer mixture you need to get extra power and smooth acceleration.

venturi. The main metering jet is calibrated to supply the correct amount of fuel for operation above idling speed and up to the power, or top speed, range. In most carburetors a well, between the main metering jet and nozzle, provides a reserve of fuel beyond the main jet restriction. This reduces the tendency of the mixture to lean out during moderate acceleration.

In some designs, the nozzle has holes that bleed air into the fuel stream. This entrained air improves atomization and helps keep fuel-to-air ratio constant.

Servicing. Missing due to carburetor malfunction manifests itself in one of two ways:

1) A dual carburetor with one jet clogged will make the engine sluggish and rough, but usually *not* uneven, since each barrel feeds every other cylinder in the firing order.

2) A single-barrel carburetor with a clogged main jet would run at idle speed and possibly with a wide-open throttle, but in between it would stall.

For these reasons, engine missing caused by faulty carburetion can usually be distinguished from missing caused by ignition trouble. When an engine is missing or holding back due to carburetor malfunction, a couple of jabs on the throttle will squirt extra gasoline into the barrels through the accelerator pump jets and the engine will pick up speed momentarily.

With ignition trouble, the opposite is usually true. When the throttle is opened quickly, cylinder-compression pressures go up and electrical resistance at the spark-plug gap increases. A weak spark due to faulty points and/or condenser will often fail to jump the gap. Instead of responding momentarily, the engine will stop dead.

If you live at or near sea level, your car was delivered with main metering jets correctly sized for the air density at sea level. At altitudes above 5,000 feet, there is an appreciable reduction in the amount of oxygen in every cubic foot of air. This will change the gasoline/oxygen ratio and the carburetor will deliver a mixture too rich for best power. If you are traveling and plan to drive at altitudes above 3,000 feet for any length of time, engine performance can be restored by having altitude (lean) jets installed.

The power system. At the top end of the engine-speed range the carburetor mixture becomes too lean for best power. At this point, manifold vacuum is quite low and a power piston, held against a spring by vac-

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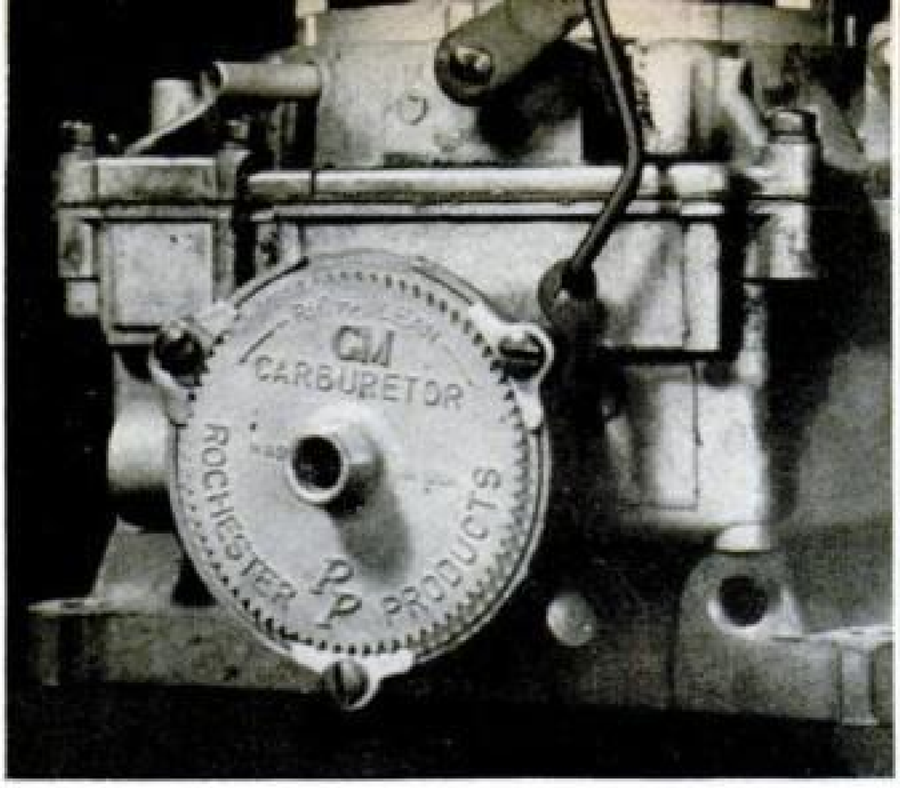
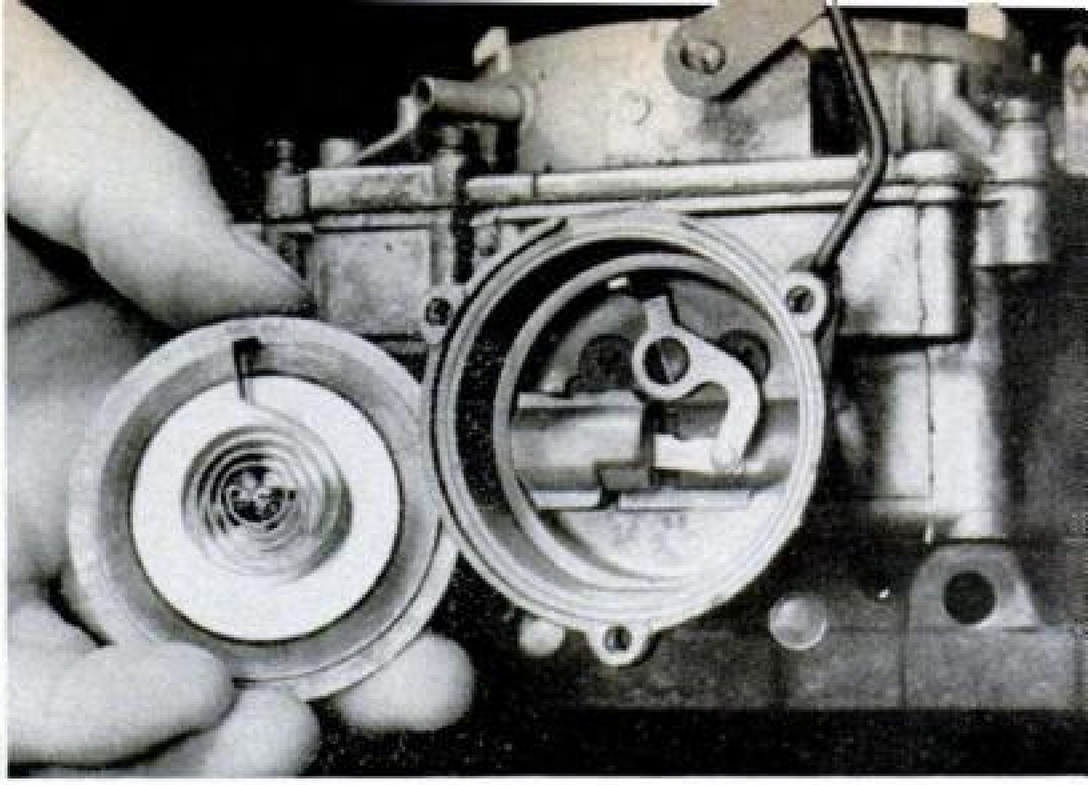


Automatic choke cover moves to adjust spring tension for best operation. Factory setting, indicated by a scribed line, should be one notch to lean side from mark for best m.p.g.



Coiled bimetallic spring inside choke tightens when cold to close butterfly valve. Warmed by exhaust gases, spring opens valve when engine reaches full operating temperature.

uum, is released to unseat the power valve. Additional gasoline is then delivered to the main nozzle and economy becomes a secondary consideration.

This system really penalizes the lead-foot since the power jet invariably opens every time you floor the throttle.

The pump system. Whenever the throttle is opened suddenly for quick acceleration, fuel delivery from the main nozzle will lag behind momentarily. The accelerating pump compensates for this lag by supplying the rich mixture needed for maximum power. Linked to the throttle arm, a pump plunger forces a quantity of gasoline through a passage that opens into the carburetor throat at or just below the venturi. Adjustment is usually provided to vary the amount and/or duration of the pump discharge by changing the pump stroke.

The choke system. When you start a cold engine, the air supply must be restricted and/or the fuel supply increased by the carburetor to compensate for the poor vaporization. An automatic choke restricts (chokes) the air intake during starting. In addition, it gradually eases the restriction during warm-up as the need for a rich mixture lessens.

During the warm-up period, the engine-idle speed must be increased to prevent stalling. A fast-idle cam, connected by linkage to the choke shaft, does this by providing a variable-height stop for the idle-speed adjusting screw.

Maintenance: The constant flow of hot air through the choke housing produces gummy deposits, which eventually cause the choke piston to stick. When this occurs it usually holds the choke open and causes hard starting on all but the hottest days.

Remove the air cleaner and observe the position of the choke valve in the air horn. *Normal* position for the choke valve is open, even after the car has been outside in the cold—the idle-speed adjusting-screw pressure on the fast-idle cam prevents choke movement as the coil spring cools off. Open the throttle slightly and the choke should snap closed—if it does not, or closes sluggishly, the automatic choke needs cleaning with one of the special solvents made for this job.

How heat kills carburetion. Either no gas at all, or too much, will cause a hot engine to stall. When you get no gas, the trouble usually is vapor lock in fuel lines or at the fuel pump. The cure here is to see that pump and lines are protected from hot spots, like exhaust pipes, by either distance or insulation.

If there is gas in the carb (check by working throttle linkage by hand and looking for a squirt of fuel into the carb), vapor lock is not your problem. Perhaps percolation (evaporation of fuel in the float chamber) has flooded your engine. The internal pressure will keep the needle valve on its seat, so the evaporated fuel simply pushes raw gas out of the float chamber into the primary throats and down into the manifold.

The cure here is to make sure that the float is at the correct level and that the fuel pump is not delivering too much fuel.

Make sure your accelerator pump and automatic choke are correctly set for summer driving, and, if the carb is in good shape, you should have little or no trouble beating the heat. ■ ■

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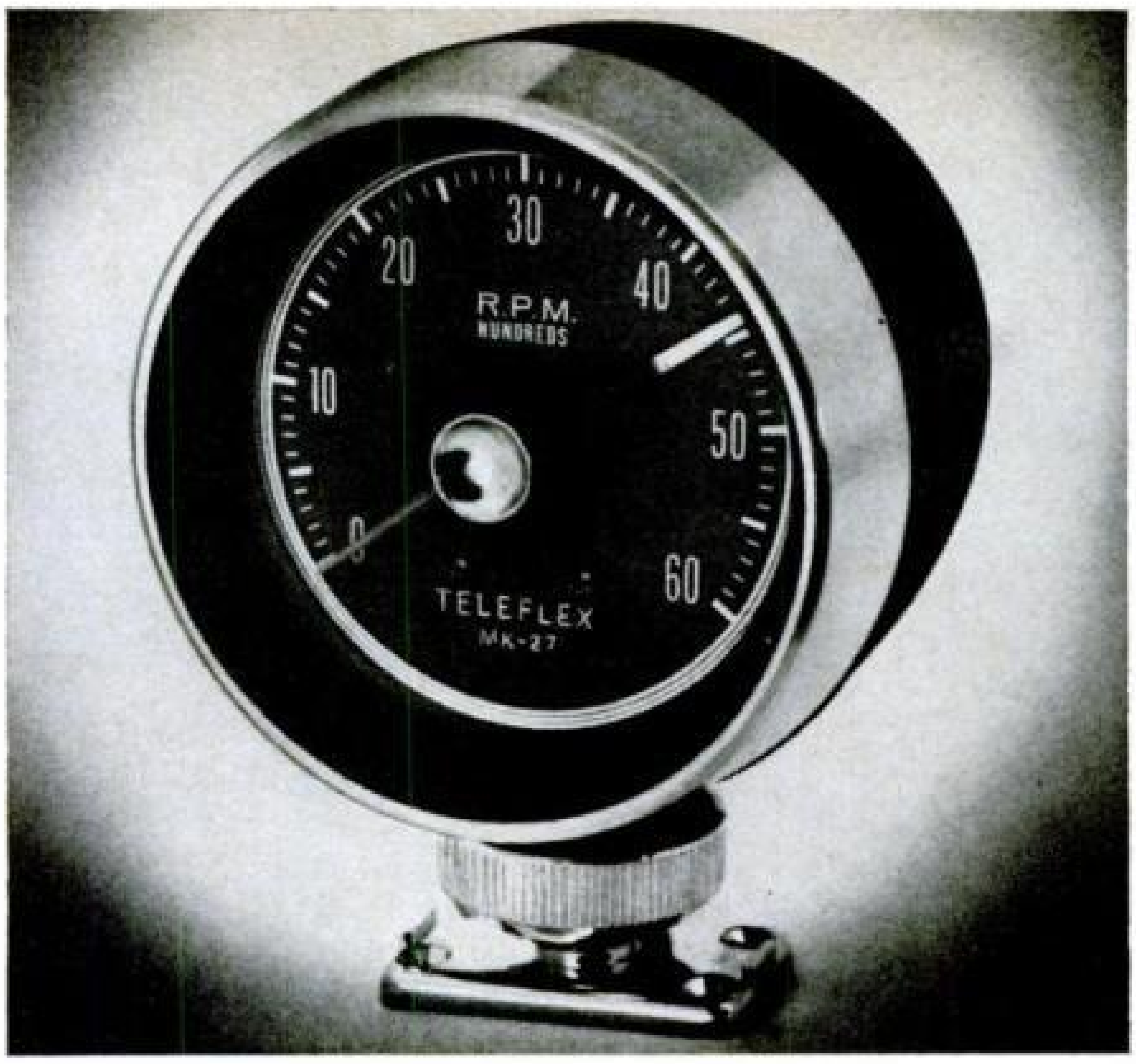
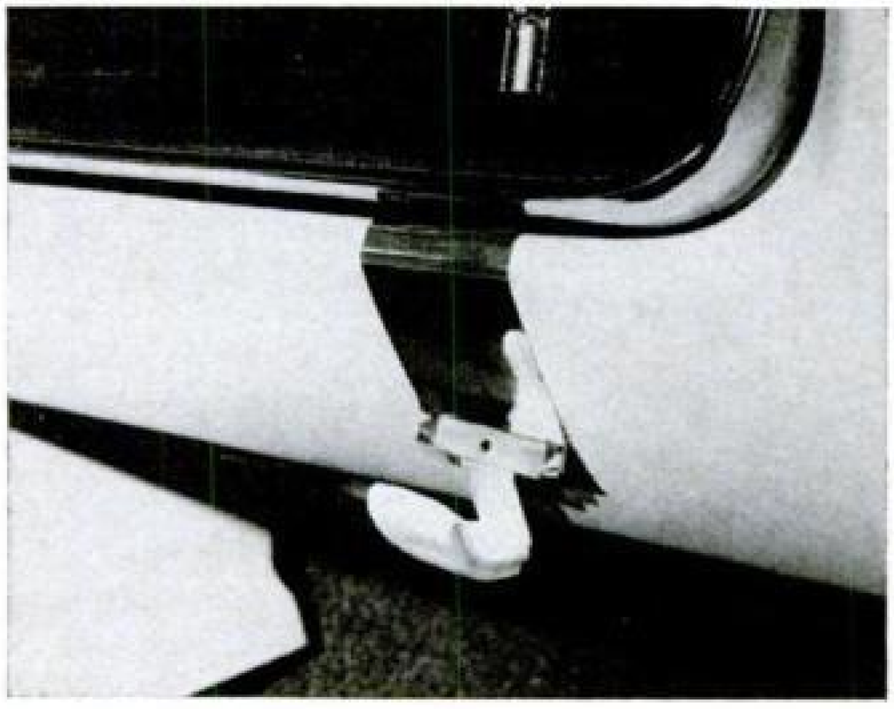


Teleflex transistorized tachometer

Teleflex's Mark 27 tach features a full 250-degree needle sweep across an illuminated face. It comes with 6,000-, 8,500-, or 10,000-r.p.m. dials (all with manually adjustable red-line). Installation requires only connecting four wires—one to the primary side of the ignition system, one to the ignition switch, one to (negative) ground, and one to the dash terminal (for lighting). Teleflex, Inc., N. Wales, Pa., recommends it for four-cycle car and marine engines.

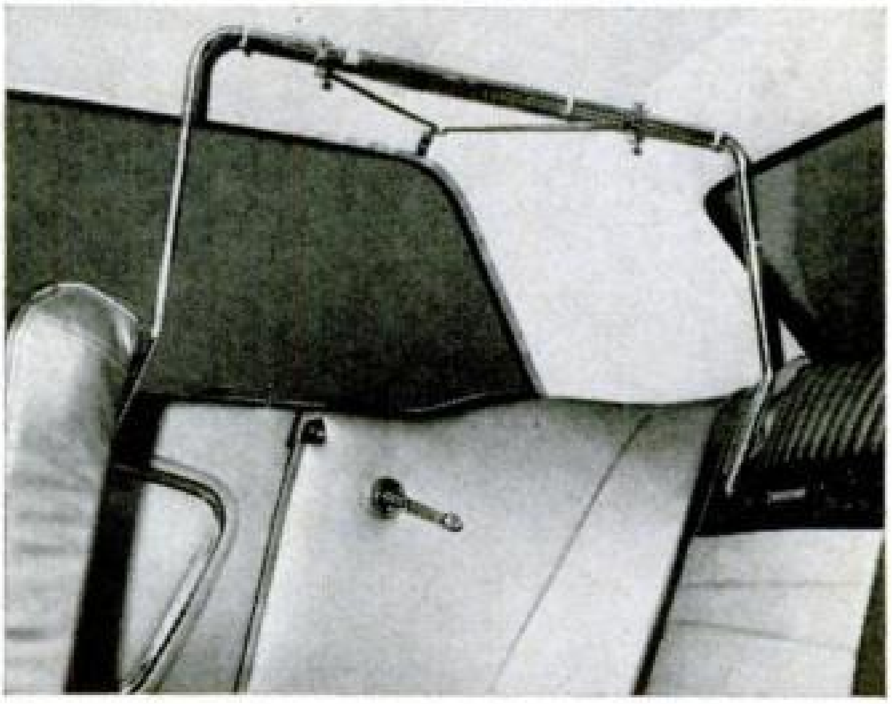
Reverse-flush adapter for auto radiators

This easily installed adapter replaces the drain cock at the lower end of your car's radiator and functions as a shut-off valve, a drain cock, and an adapter to which the garden hose can be attached to backflush the cooling system. It's a permanent fitting; price, about $2 from A. J. Yablon & Associates, Box 1188, Burbank, Calif.



Tape-on ladies' handbag hanger

The days are long gone when ladies used to pull out the choke handle when they drove off because it was so convenient for holding a handbag. Since automatic chokes came in, handbags are all over the seats. This little hook fastens to the dash like a Band-Aid, costs $1 from Pontiac Specialties, Box 477, Pontiac, Mich.



Back-seat clothes rack fits all cars

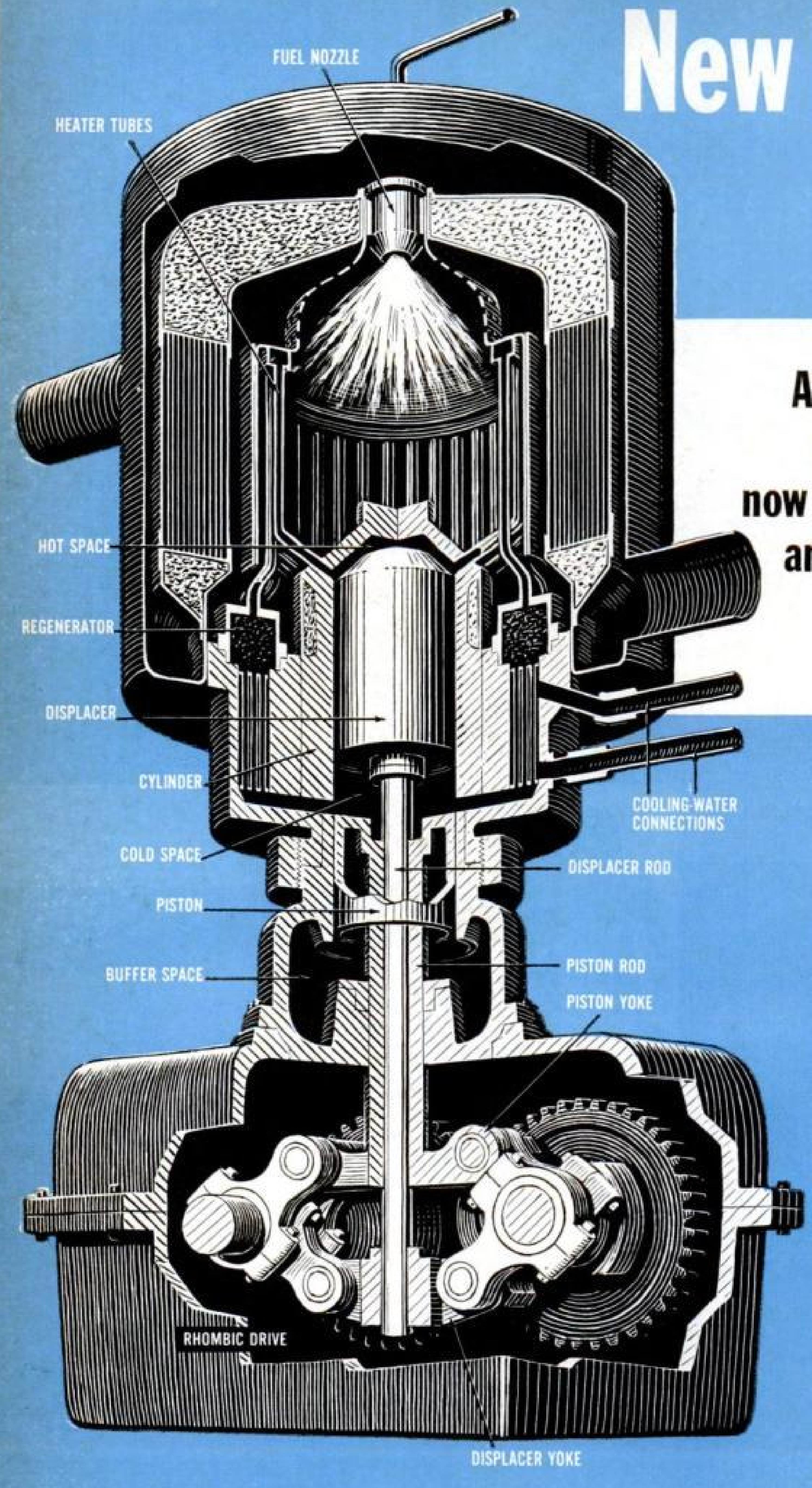
The Travel-Mate rack runs between front-seat backrest and the top of the rear seat, and is held in place by a bar you hook on to the standard coat hook. It's easily adjustable for length, and pliable metal clamps bend to follow seat contours for secure positioning. Price: $9.98 from C. G. Jones, 2002 Paige St., Georgetown, Tex.

Urheberrechtlich geschütztes Material

New Engine

Already built for satellite use, it now challenges gas and diesel power

By Harry Walton



Strange crank geometry makes a perfectly balanced one-cylinder engine possible for the first time. The working medium—air, helium, or hydrogen—is completely sealed off in the cylinder and in a buffer space below. It is moved from a hot space to a cold one by a transfer piston or displacer. The engine has two power pulses every revolution.

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for Space Does Down-to-Earth Jobs

ONE of the most exciting prime movers of the space age is a weird piston engine that can run on the moon or under water. It has already been built to generate electricity from sun heat while orbiting the earth. It may drive explorers' vehicles on alien worlds. Instead of earth fuels, it would use solar heat collected by immense portable reflectors and stored in insulated tanks.

Right now, this engine could propel nuclear submarines or the family boat. On common fuels, it can run quiet power mowers and generating plants, perhaps give us cars that have neither mufflers nor transmissions and release no monoxide. In underdeveloped countries, solar-powered engines could convert sunlight into

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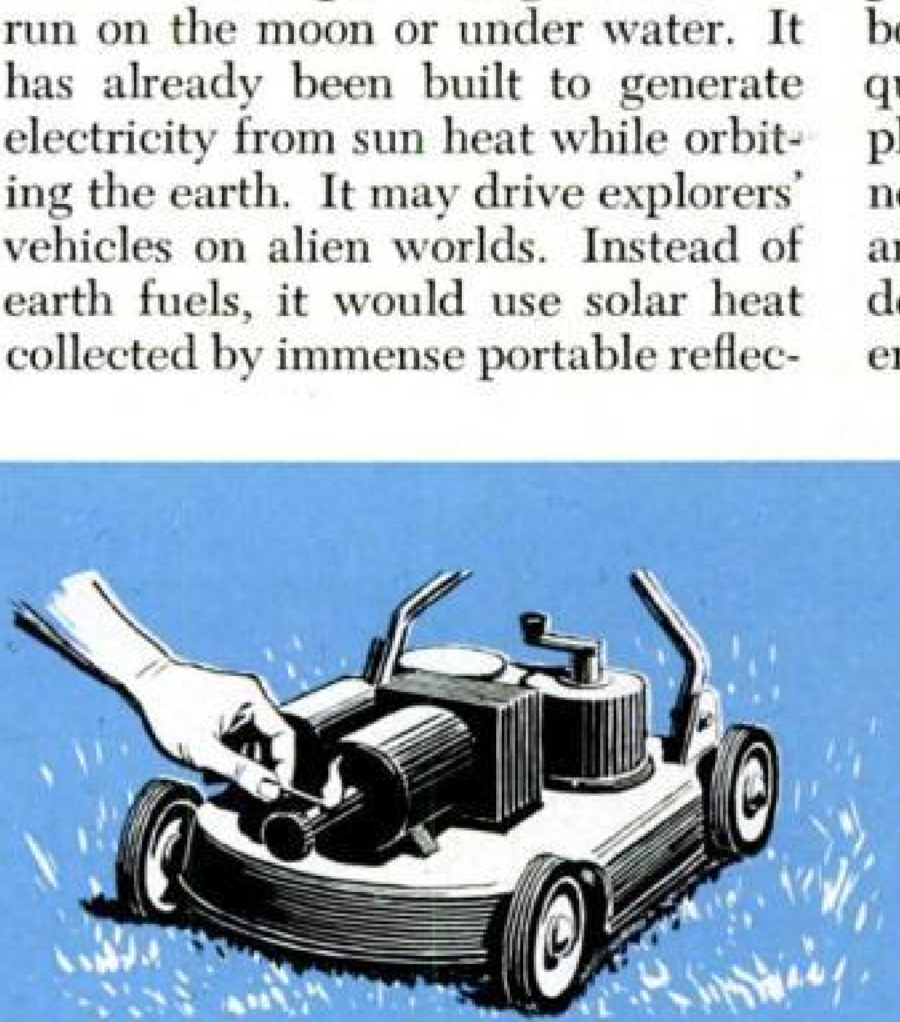
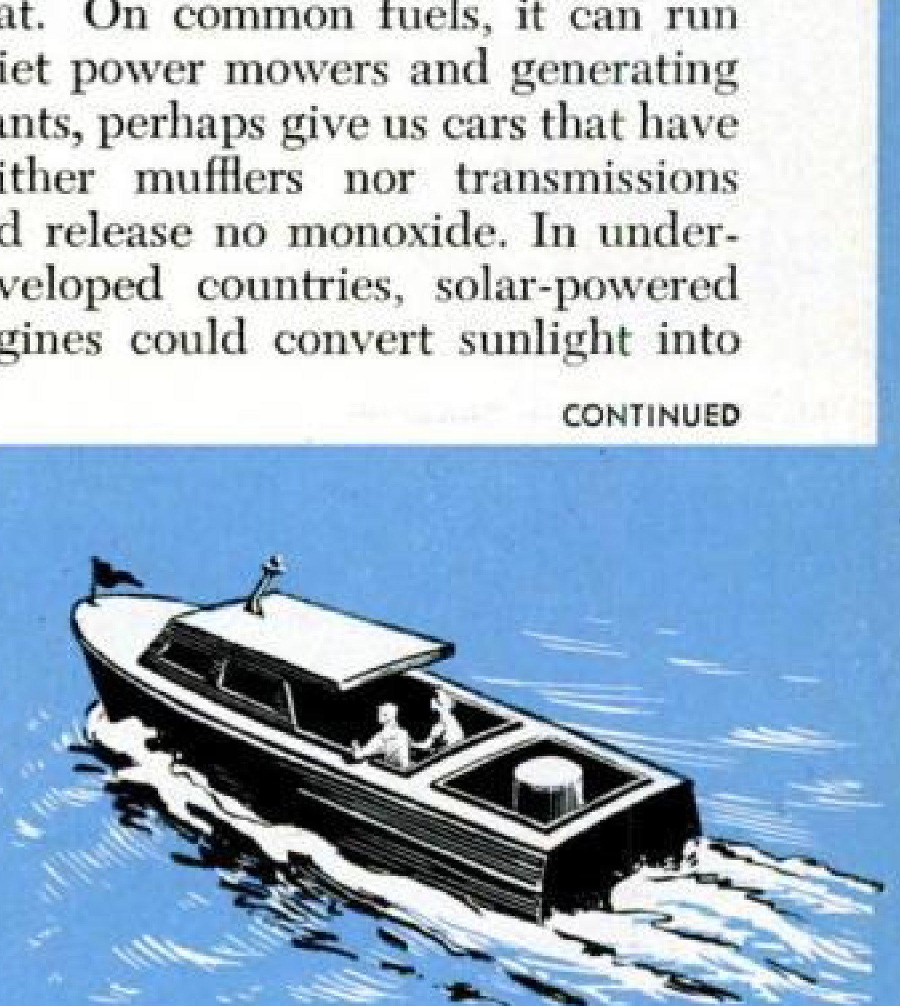


Quiet mowers you might start with a match are a possible application of the hot-air engine.



Inboard or outboard boat engines would be highly efficient, almost silent, very reliable.

Pumps and generators run by solar heat would be feasible for countries having little fuel.

Satellite engine would drive generators on sun heat collected by an immense reflector.

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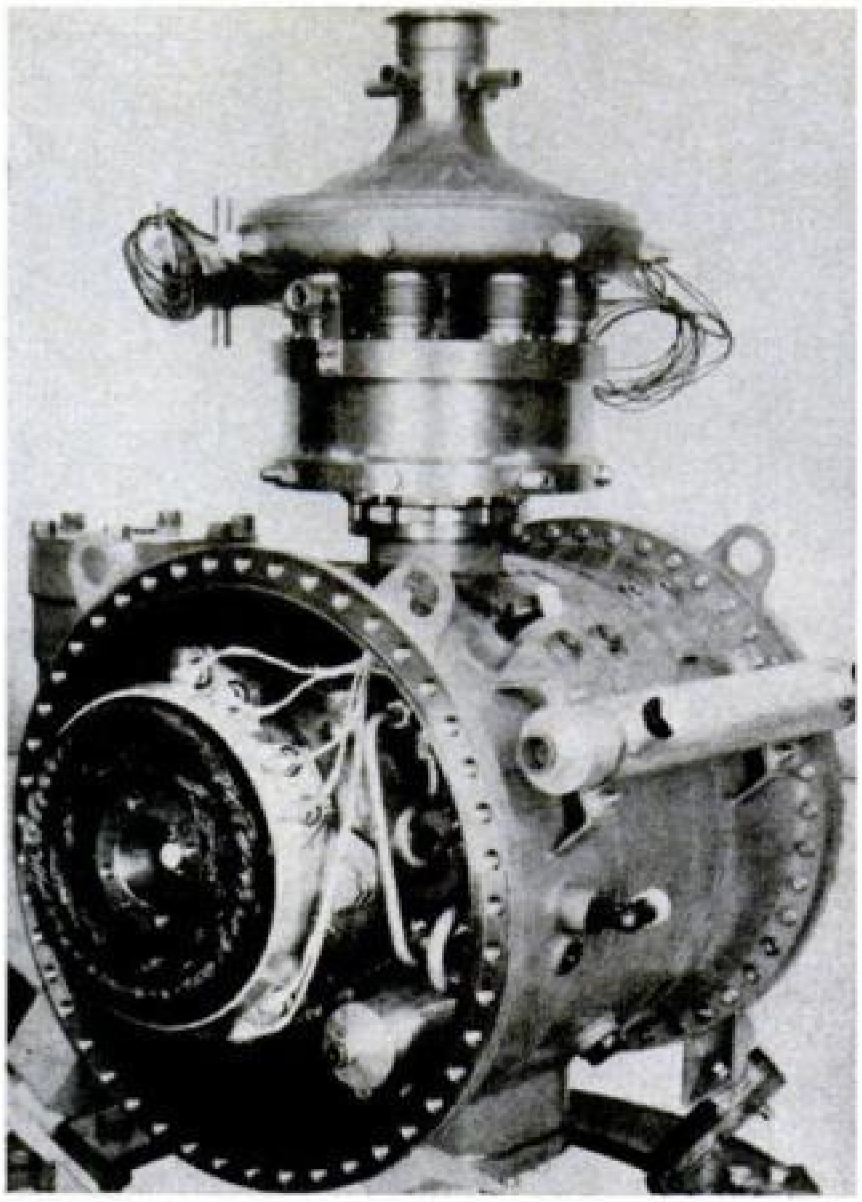
Hot-air engine's applications range "from below

Listening to the pulse of an eight-horsepower engine with a stethoscope is one of the top men in GM's Research Laboratories, F. E. Heffner. Heffner delivered a paper on present and future applications of the Stirling engine before an automotive-engineering group last January.



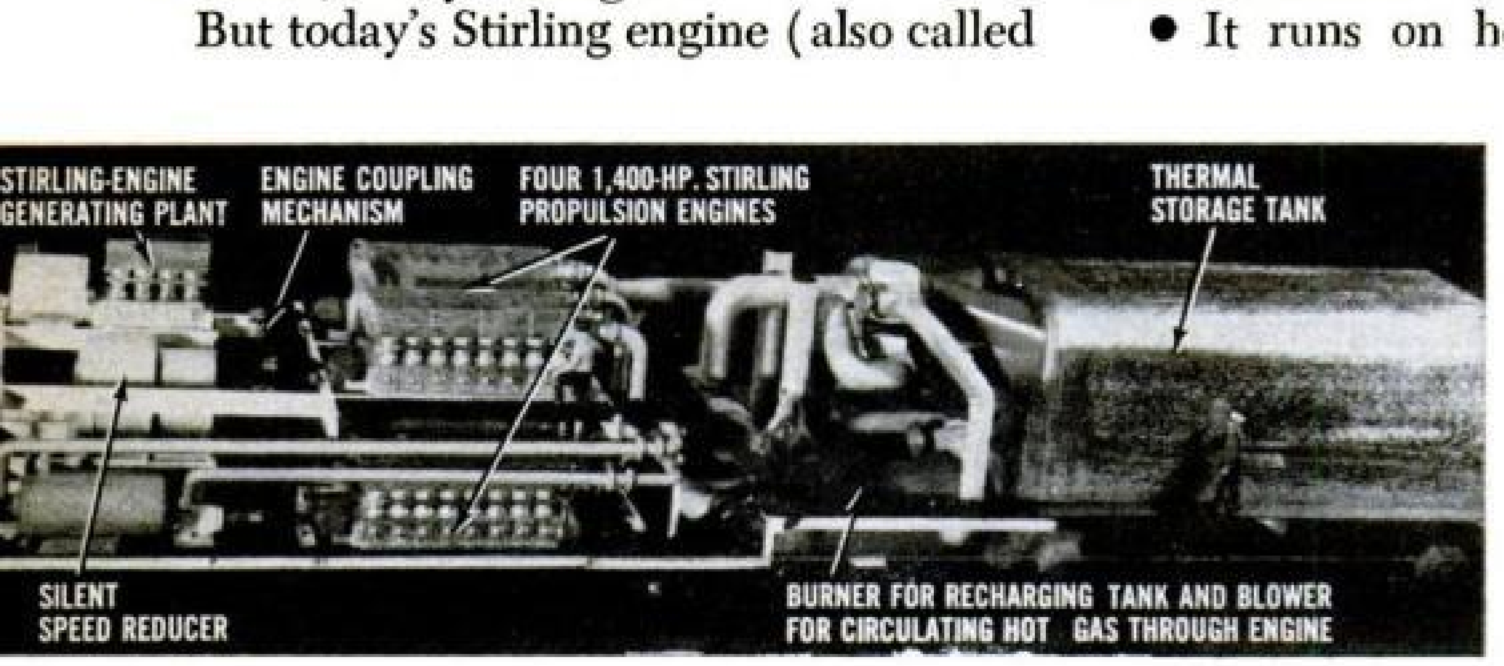
Ready for space, this solar-powered satellite generating plant is the first to be built. With its covers off, one of the twin generators is visible at left. In space, the entire unit would be sealed in an atmosphere of helium (or possibly hydrogen), which is the engine's working fluid.

kilowatts. Your vacation home might use a sun-charged energy bank and engine to pump water or provide electricity.

Pistons are back. In this age of jet turbines and rotary engines, this one with its two pistons per cylinder seems a throwback. In a sense it is. The basic patent was granted to Robert Stirling, a Scottish minister, 149 years ago.

But today's Stirling engine (also called hot-air or hot-gas engine) is like its inventor's only in principle. Updated by modern thermodynamics, space-age metallurgy, and a strange twin-crank mechanism, it's a breakthrough on several counts:

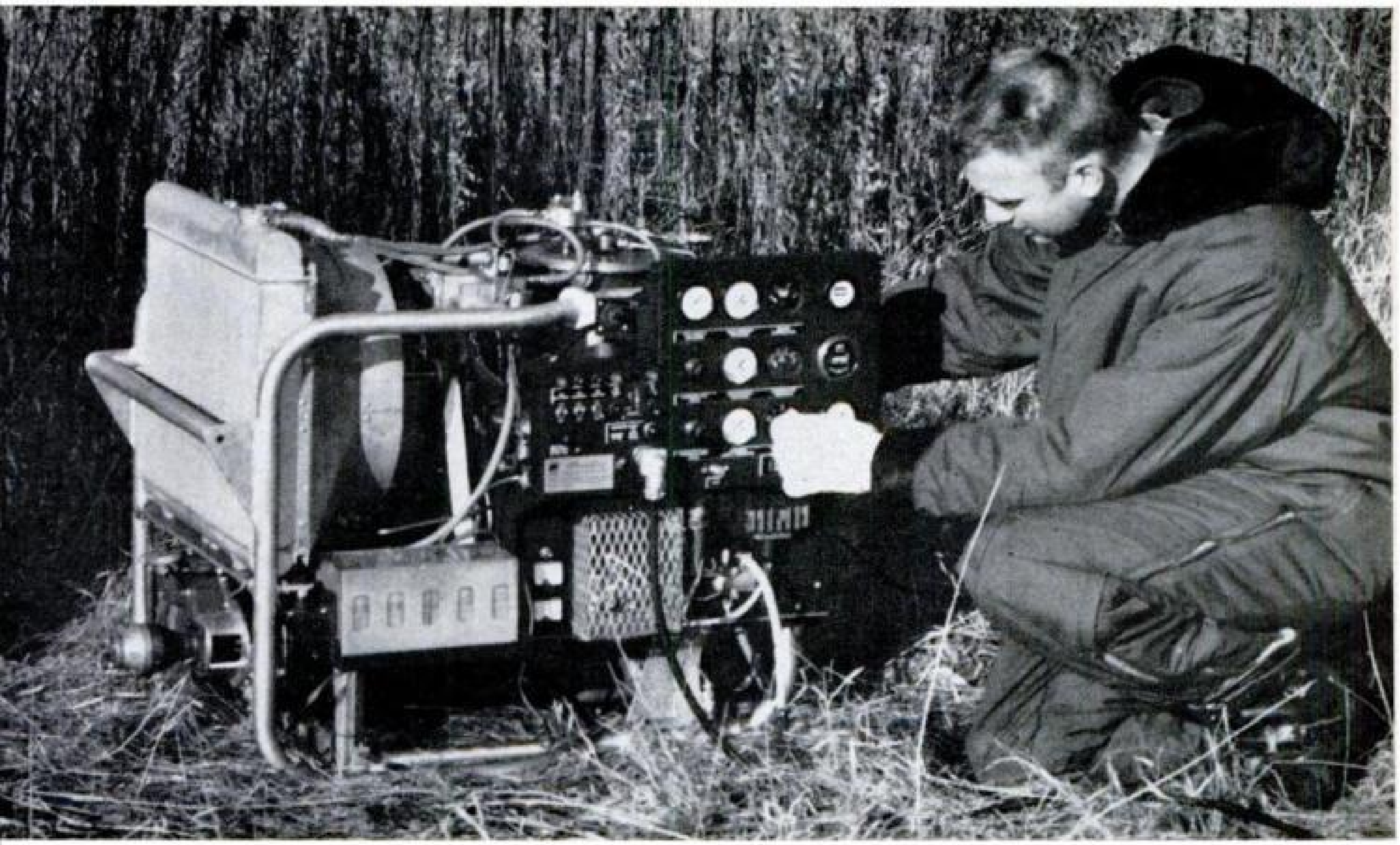
- It has no valves to clatter, no exhaust to bark. It's so quiet the Army is testing Stirling-driven generators for field use in combat areas.
- It runs on heat, and doesn't care



A tankful of heat could give a submarine eight times the underwater range of battery drives. At left is a model of such a system. Oil heats aluminum oxide pellets to 2,800 degrees. Circulating air carries the heat to Stirling engines.

Urheberrechtlich geschütztes Material

the sea to outer space," says GM's F. E. Heffner



Second ground-power unit delivered for the U.S. Army's quiet-engine program underwent 500 hours of testing, most of it at full load. It was the only one of several engine-generator packages to successfully complete this tough evaluation run. A new unit, scheduled for delivery this year, weighs 40 percent less. The GPU consists of a one-cylinder Stirling engine, a big cooling system, and a three-kilowatt generator that can deliver power 90 seconds after burner is lit. The Army's target—an engine-generator package that can't be heard more than 100 feet away.

whether it's from a straw stack or a nuclear pile. It can be designed to work on *any* heat source, from barbecue charcoal to a tame volcano.

• Its twin-crank design makes even a one-lunger vibrationless. Because the two shafts turn in opposite directions, all gyroscopic effects cancel out. On earth, that means a smoother engine; in space, one that won't cartwheel out of its calculated position.

• It has no ignition system. The coil, points, and condenser of the gas engine are eliminated. So is the finicky injection system of the diesel. A Stirling engine is as reliable as a crowbar. Once hot, it starts at a flip.

• Its efficiency is high—up to 39 percent on test units. That equals the very best diesels, is way ahead of gas-turbine and rotary engines.

Since 1958, as I reported in PS, May

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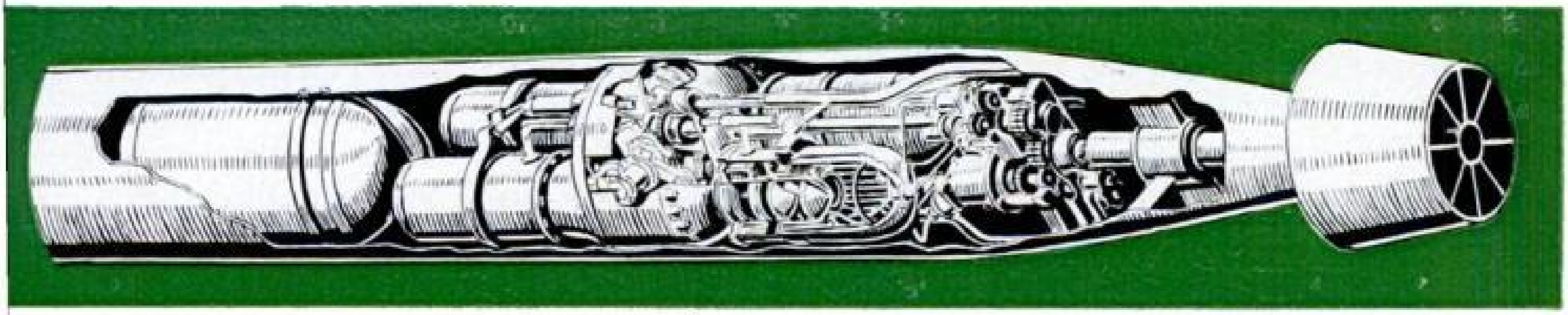

Muscle for attack is seen in drawing above—GM's design for a torpedo power plant. A four-cylinder opposed Stirling engine is crammed into a standard 21-inch torpedo. It will develop 578 hp., almost 50 hp. per cubic foot, and reach top speed 12 seconds after firing.

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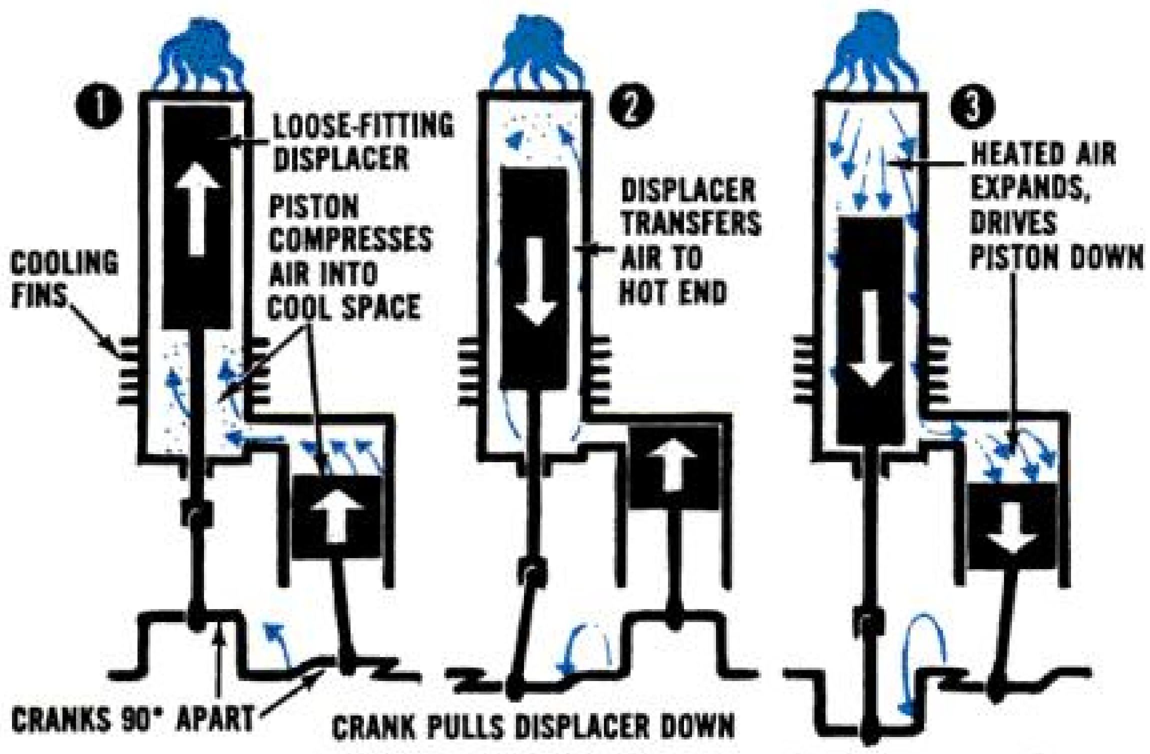
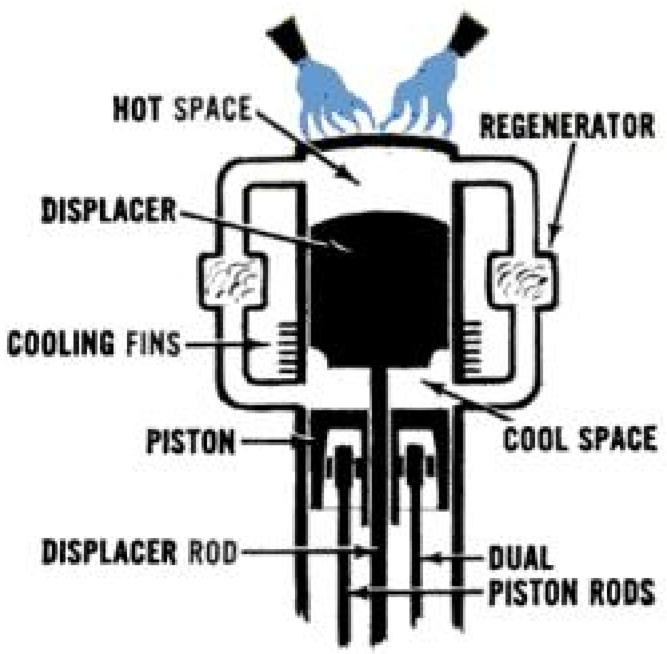
How the 149-year-old hot-air engine works and how it has changed



Simplest Stirling engine has separate displacer and power cylinders. The displacer is a loose fit to let air flow around it. The power piston is a close fit, its crank a quarter turn behind that of the displacer. As the piston is pushed in (on starting or by flywheel momentum) it compresses air into the finned cold space of the displacer cylinder (1).

When the power piston is at the top of its stroke, the displacer has moved halfway down and transferred some of the air to the hot end (2). The compressed air expands as it is heated (3) and drives the power piston out, while still more air is transferred as the displacer moves farther down.

As the displacer moves up again, it transfers air back to the cool space to be recompressed. Because of slight air loss, the cooled air is below atmospheric pressure, which therefore pushes the piston in for a second power pulse.



More advanced design has displacer and piston in the same cylinder. The displacer is a close fit, transferring air between the hot and cold spaces through tubes outside the cylinder. These tubes afford extra heating and cooling area. The regenerator, also Stirling's invention, is packed with thin plates or wire. In passing through it from the hot space, the air gives up most of its heat to this material. Returning from the cold space, the air picks up this stored heat from the regenerator, which thus saves much fuel. In practice, tubes and regenerators are spaced all around the cylinder. Displacer rod passes through the piston, while dual piston rods straddle the displacer rod.

'60, General Motors has been pushing research under license from N. V. Philips Gloeilampenfabrieken. This Dutch industrial giant started it 20 years ago in search of an engine to run small generators on available fuels. The neglected Stirling engine looked promising. It has no boiler to explode, runs on anything that burns, and in theory could be more efficient than any other heat engine known.

It took time and brains to make the promise pay off. But today GM has big plans for Stirling power plants—"from five to 5,000 horsepower for applications ranging from below the sea to outer space," said F. E. Heffner, of the GM Research Laboratories, in an S.A.E. paper.

Projected engines range from capsulated ones for satellites to huge machines for generating plants. In between are marine engines, stored-energy drives for submarines, and fiercely powerful, amazingly compact torpedo engines. Test units have been built under contract for the Army, Navy, and Air Force.

How it's different. Gasoline and diesel engines are internal-combustion engines. They gulp a cylinderful of air, compress it as the piston moves in, then burn it with fuel inside the cylinder. The heated air and hot combustion gases expand, driving the piston out. Having the fire in the cylinder makes such engines choosy about fuel, requires air to be mixed with it in just the right ratio, and leaves some ashes (carbon, acid, other harmful stuff) inside.

The Stirling is an external-combustion engine working on a closed cycle. No air goes into the cylinder, no exhaust comes out. Only heat is transferred. The work-

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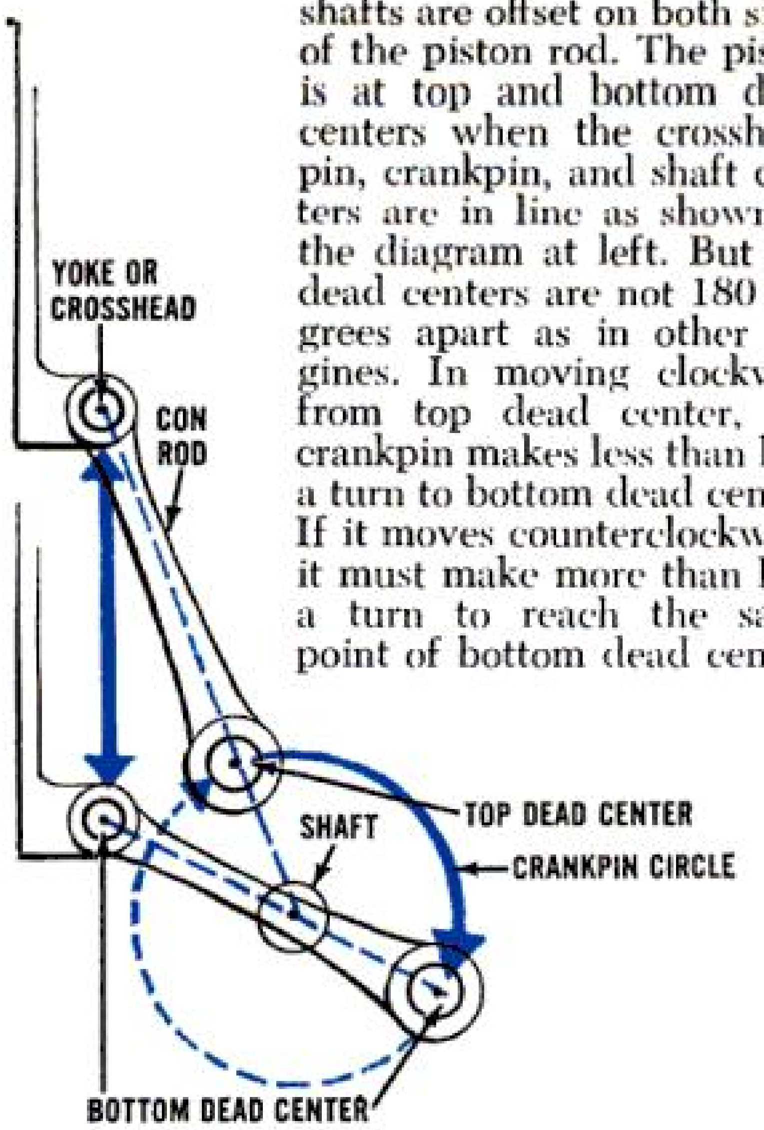
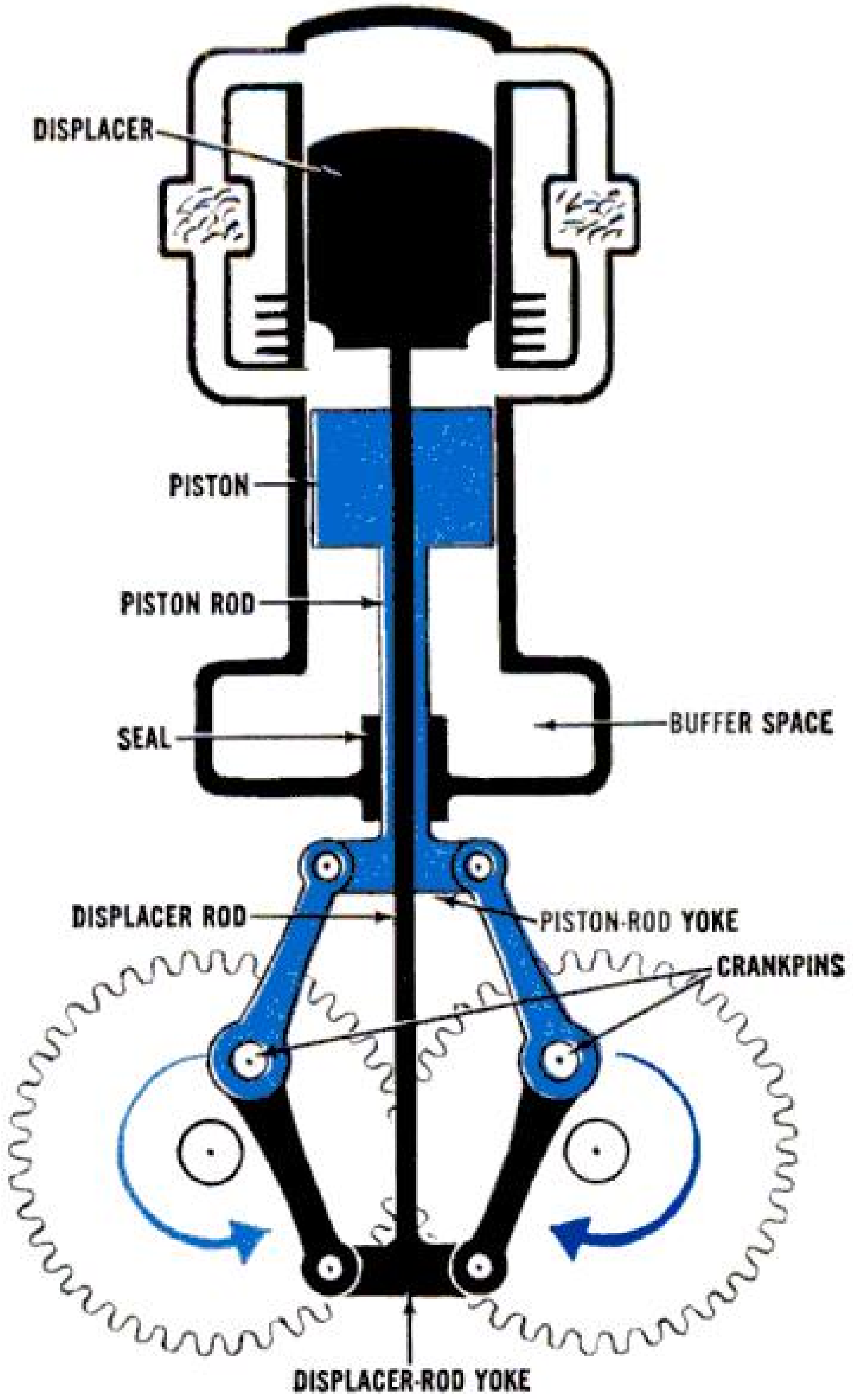


In the rhombic drive, twin shafts are offset on both sides of the piston rod. The piston is at top and bottom dead centers when the crosshead pin, crankpin, and shaft centers are in line as shown in the diagram at left. But the dead centers are not 180 degrees apart as in other engines. In moving clockwise from top dead center, the crankpin makes less than half a turn to bottom dead center. If it moves counterclockwise, it must make more than half a turn to reach the same point of bottom dead center.



In today's Stirling engine, a crosshead or yoke on the piston rod, and another on the displacer rod, are joined by links or con rods to a common crankpin on each of the two shafts. These are geared together so that the crankpins follow identical though opposite paths. Link and shaft spacing gives the displacer a 110-degree lead over the piston. A pressurized buffer space is added.

ing medium—air or a gas—shuttles back and forth inside. First the power piston compresses it into a cool space. Then a second piston—better called a displacer—moves the compressed medium into a space kept hot by an external heat source. There it expands, driving the power piston out.

Compression is a modest 2.5:1, instead of the 8, 9, and more of gasoline and diesel engines. As the Stirling's working medium is heated progressively instead of in one explosive instant, energy is applied as a vigorous push rather than a hammer blow. Even more important: As the medium is cooled, its pressure falls *below* that on the outside of the power piston, which is therefore pushed *in*.

This gives the Stirling two power pulses per revolution—twice as many as a two-cycle gas engine, four times the number of a four-cycle gas engine. Peak torque of a one-cylinder Stirling *without flywheels* is only 3.5 times its mean output torque. A four-cylinder Stirling engine is as smooth as an *eight*-cylinder, *two*-cycle diesel engine, twice as smooth as a V-8 car engine.

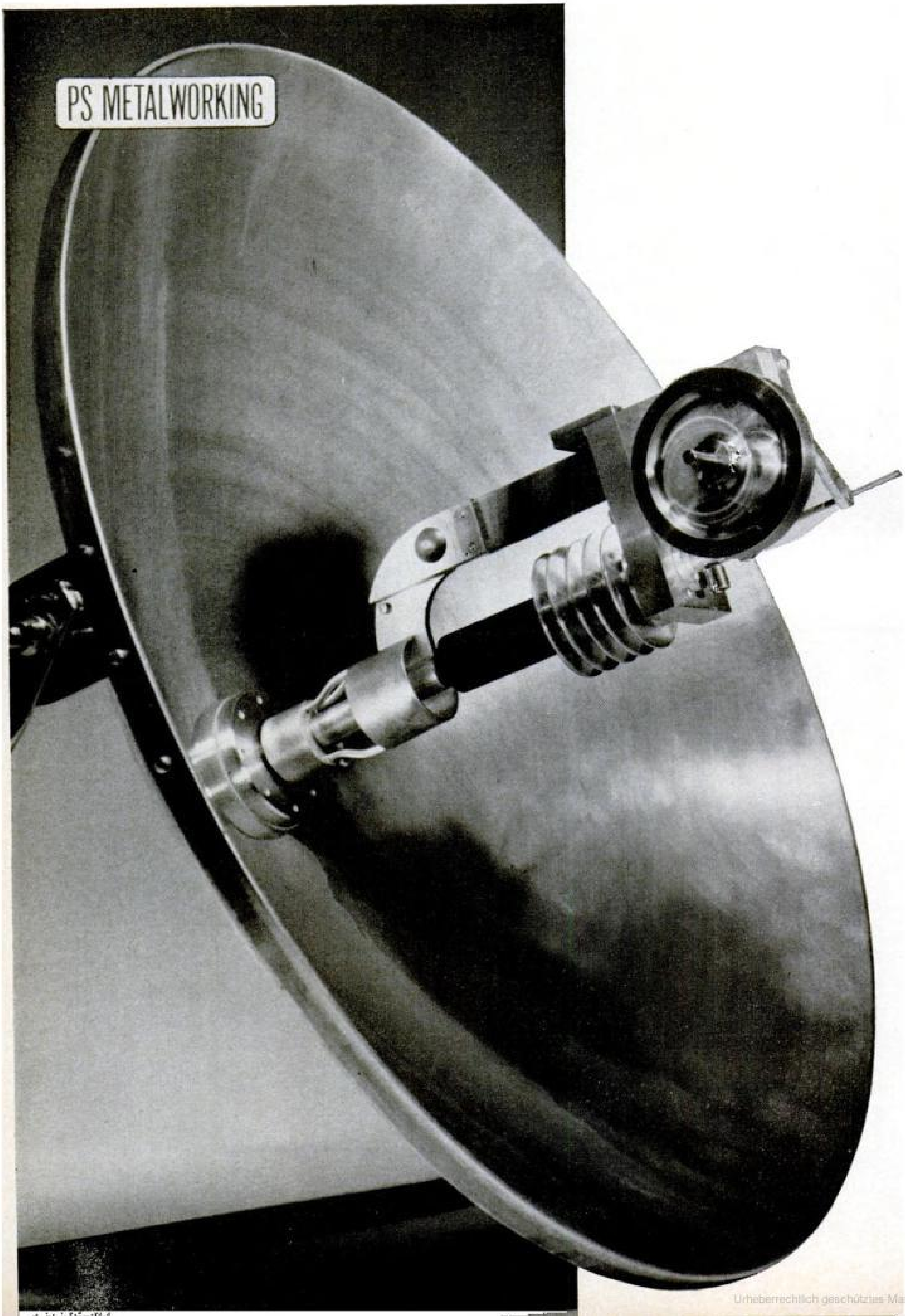
Working pressure in the Stirling cylinder is 1,500 to 2,100 pounds per square inch. But it's tamed by a pressure of about 1,000 p.s.i. in a buffer chamber under the piston. Maintained by a small pump or a pressurized tank, this buffer pressure minimizes leakage, lightens compression loading and mechanical stresses.

But the chief reason for this high internal pressure is to give the engine more working medium and so increase its power. In effect, the Stirling is supercharged without driving a supercharger.

[*Continued on page 174*]

Want to build a model Stirling engine the sun can drive? Turn the page

Amazing No-Fuel "Space"



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Engine You Can Build

By Harry Walton

FOCUS sunlight on this model engine, and it runs at full speed, fueled by the biggest nuclear reactor in the solar system—the sun.

Power is ample to drive a midget water pump or spin a display turntable. For indoor exhibits, such as in Science Fairs, a heat lamp can replace the sun. As a mantelpiece model, the engine can be operated on paper matches, alcohol, or fuel tablets.

If you have no lathe, you can buy all parts machined in a kit. With a small lathe, you can make the engine of common materials: electrical conduit, brass tubing, a metal cigar tube, ½″ dural plate. A kit of materials is also available.

Mount stock for the engine frame in the lathe and bore the cylinder recesses as shown in the step-by-step drawing. Recesses and cylinders may be threaded, but it's easier to make them push fits and cement the cylinders in.

Boring the displacer recess breaks through the port to the power cylinder. Don't forget to drill and tap the hole for the gland before removing the piece. Bore the bearing

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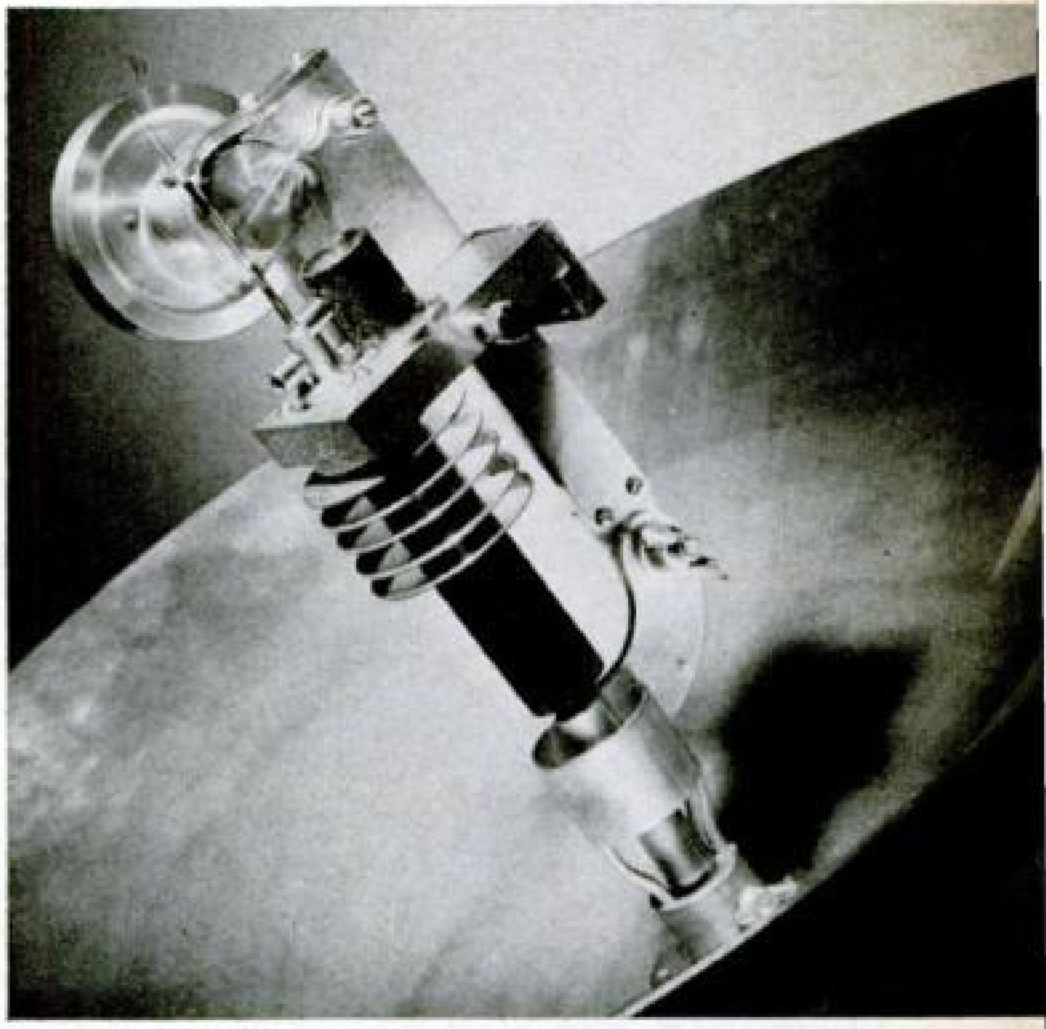

Mounted inside an 18″ reflector so that sunlight is focused on the end of the displacer cylinder, the engine runs at full tilt. Wear dark glasses to protect your eyes from the hot spot.

Setup is reversed for an 8″ auto-headlight reflector, which operates engine at moderate speed with kerosene used as a lubricant. A tilt base facilitates aiming reflector at heat source.

A PS reader showed us how to harness the sun

First published in PS in 1961 for alcohol firing, this model Stirling engine has been built by many readers. One of them, Mr. Valmer Nixon of Ottawa, Canada, a technical officer of the National Research Council, added such refinements as a sliding block for the crankpin to turn in, and an outboard displacer-rod bearing.

Intrigued by the idea of operating the engine on solar energy, he did so with both an 8″ auto-headlight reflector and a spun-aluminum reflector (photos at right).

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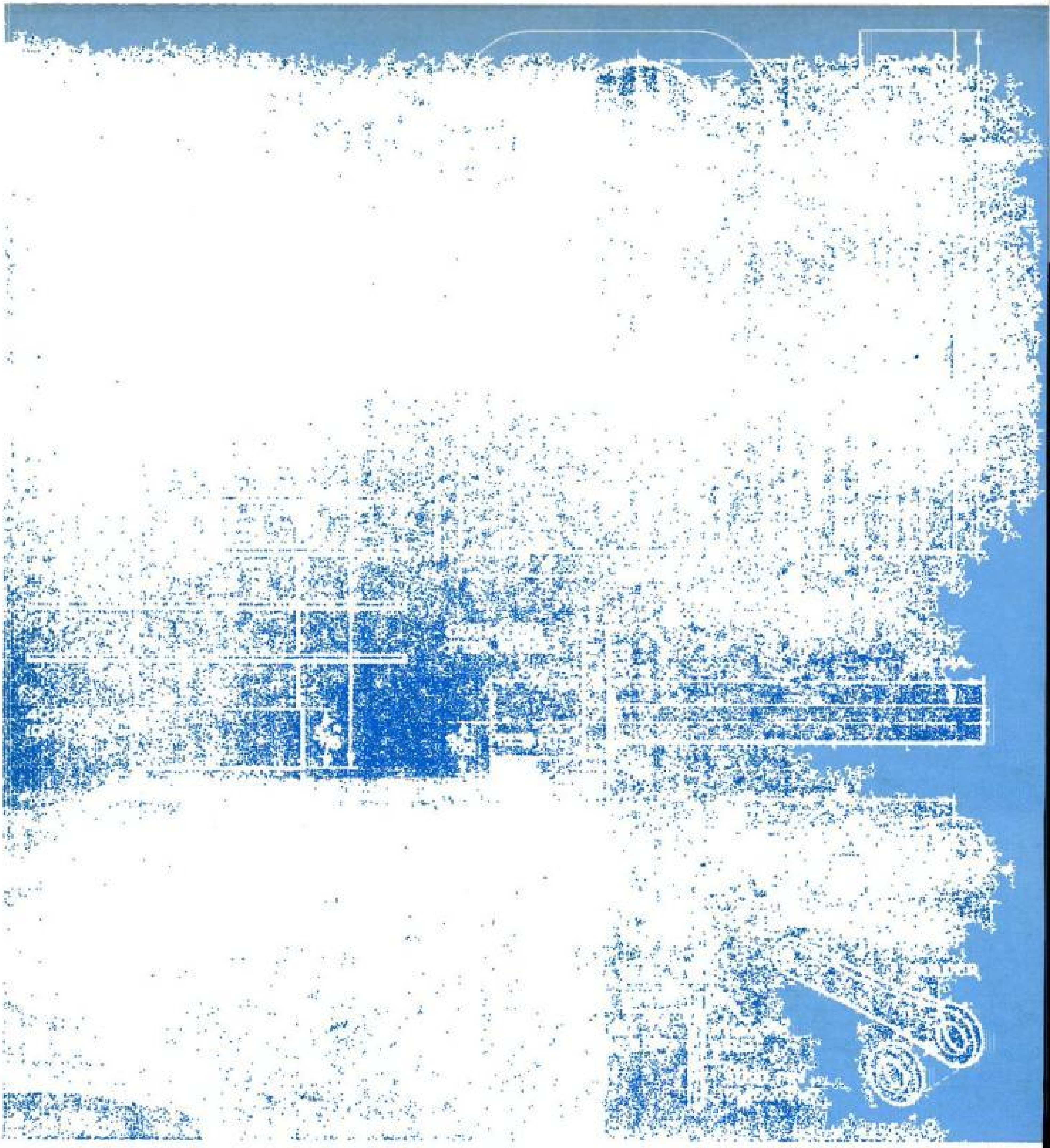

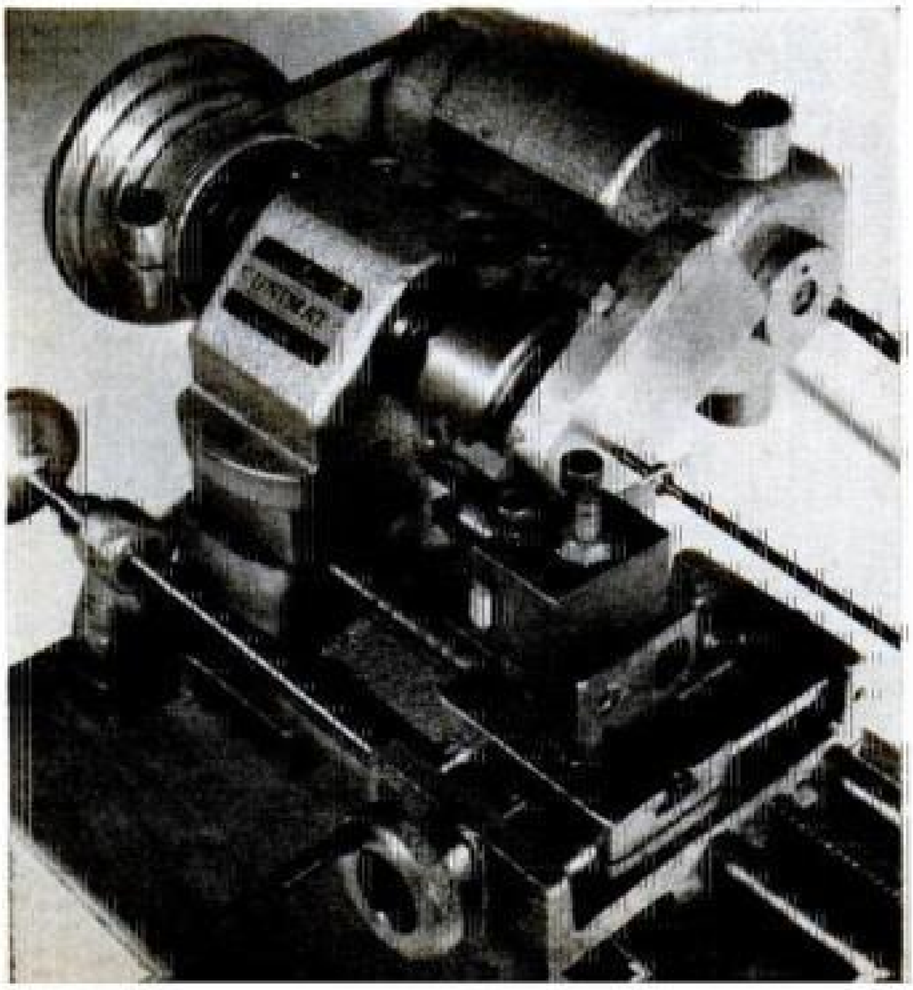

plate as shown. After boring the housing, press it squarely into the plate.

Drill tapping-size holes through the cylinder standard into the plate for two $\frac{3}{16}$" bolts. Ream out the holes in the standard to clearance size; tap the others.

To align the crank disk, shaft, and crankpin, follow the sequence shown. After cutting off the disk, chuck it by the shaft and face the outside. Support it on the

Use a center finder—a rod with a ball driven on near one end—to locate centers for boring cylinder recesses. By filing off bottom corners of the workpiece and using a raising block under the headstock, it becomes possible to do the machining job on this small lathe.

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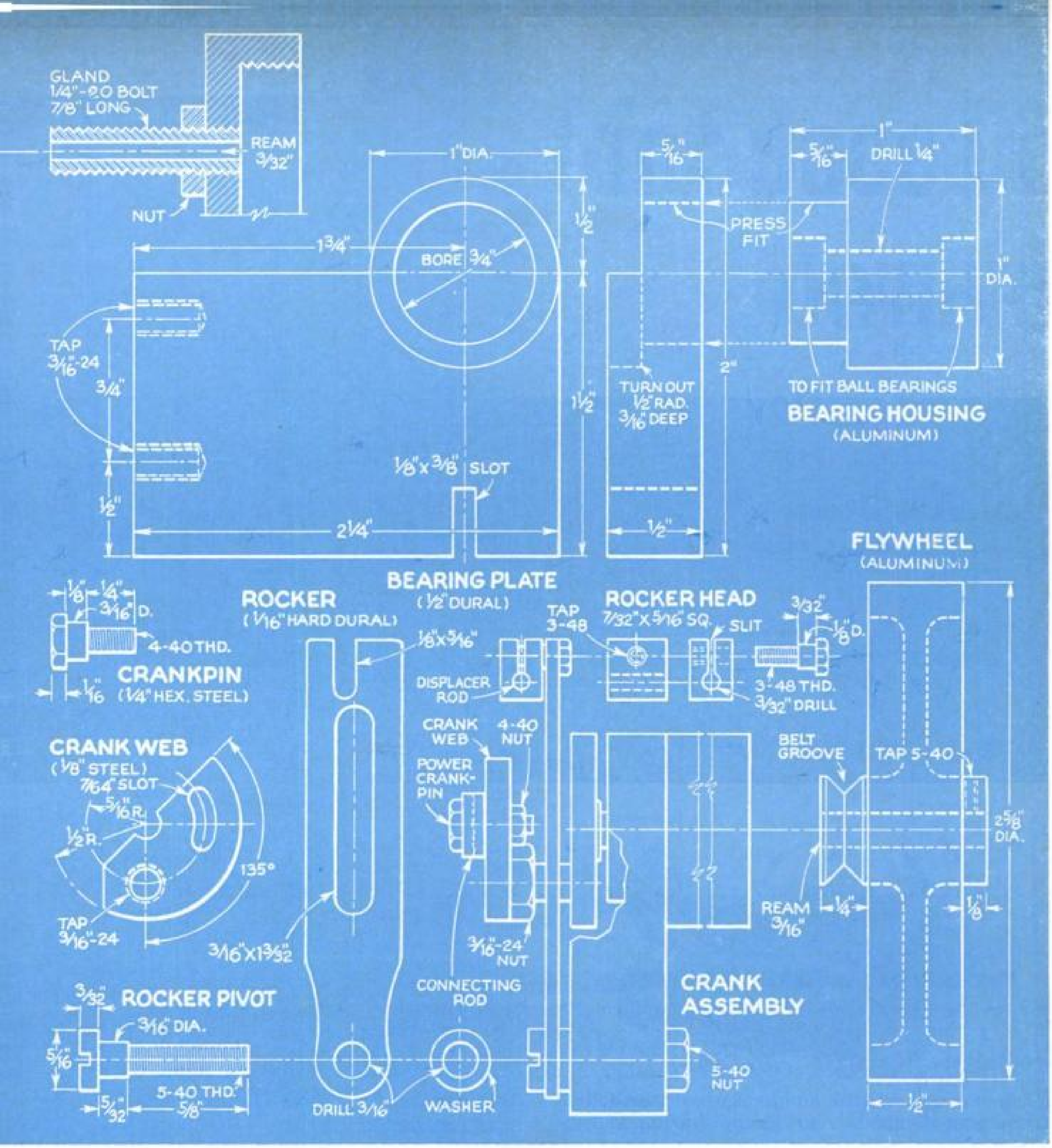

ends of the chuck jaws to press the crankpin in with the tailstock feed.

The displacer cylinder is made of thinwall steel conduit. Twist a 3½″ piece onto a tight-fitting arbor center-drilled for tailstock support. Turn down all but 5/16″ of its length to leave a wall less than 1/64″ thick. Leave the 5/16″ unturned portion at one end the original diameter.

To close the thinwall end of the cylinder, first solder a bit of sheet copper to a scrap of tubing you can chuck. Turn the copper to a close fit in the cylinder. Melt the disk free and silver-solder or braze

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Where to order engine kits

Machined engine parts and an 18″ reflector with engine mount can be ordered (by number) from Techni-Kits, Dept. S, 350 Broadway, NYC 10013.

705 Machined engine kit $19.95
706 Reflector and mount 7.95
707 Machined engine kit, reflector, and mount 24.95
708 All materials for machining engine, ball bearings, flywheel casting, glass foam 9.95

For postage and handling, add to the above prices 50 cents east of the Mississippi, $1 west of the Mississippi.

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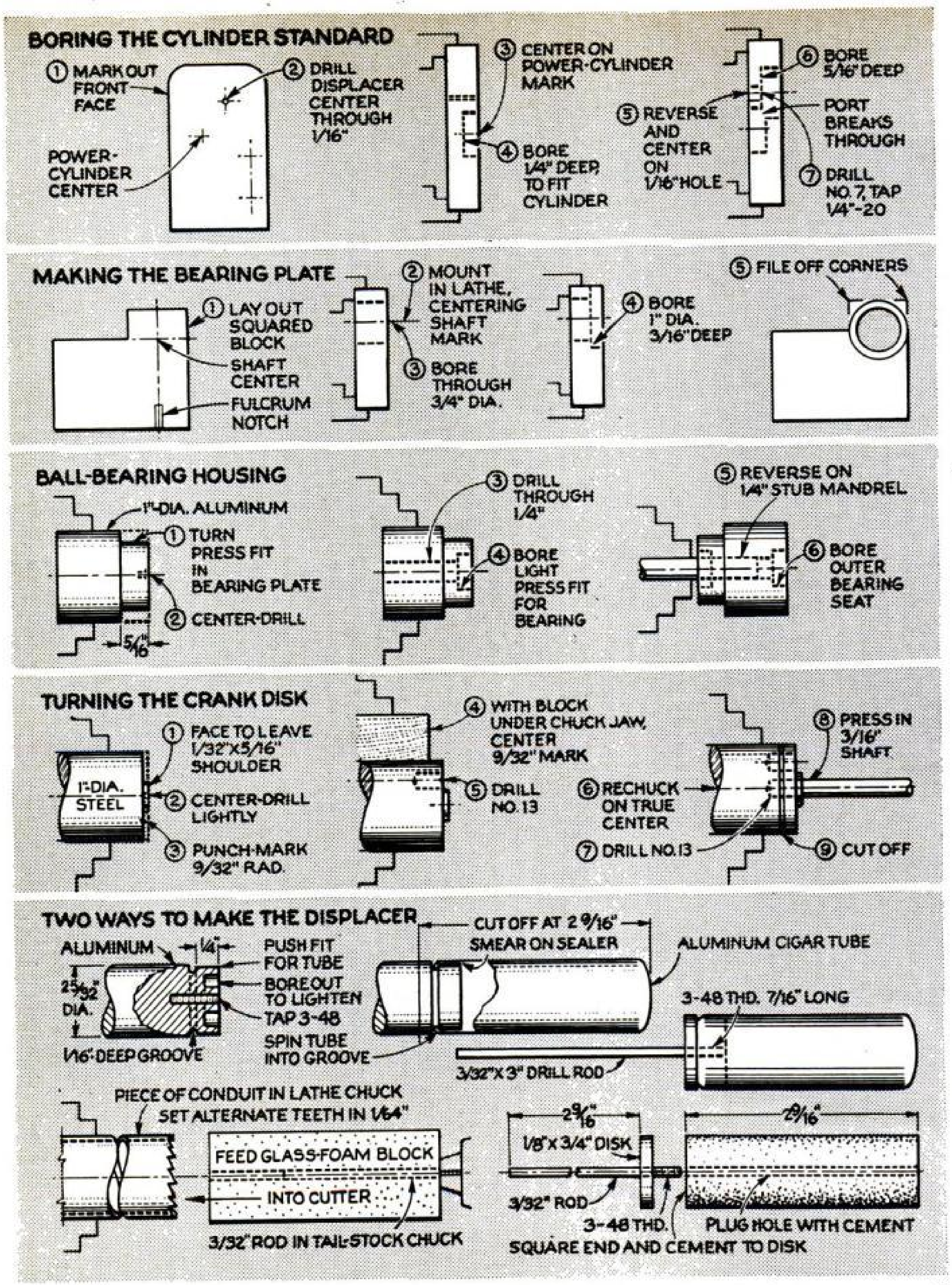

it into the cylinder. Soft solder won't do. Check for air leaks by blowing into the open end with the joint under water.

Cut fins out with a circle cutter. Chuck them and bore to a slip-on fit on the displacer cylinder. Cement them in place.

The displacer must be loose in the cylinder to let air pass it, but not so small that it leaves much air undisplaced. Coat the turned head and the inside of the cigar tube with cement before joining them. Put cement on the threads of the rod before screwing it in. Hold the finished displacer

[Continued on page 176]

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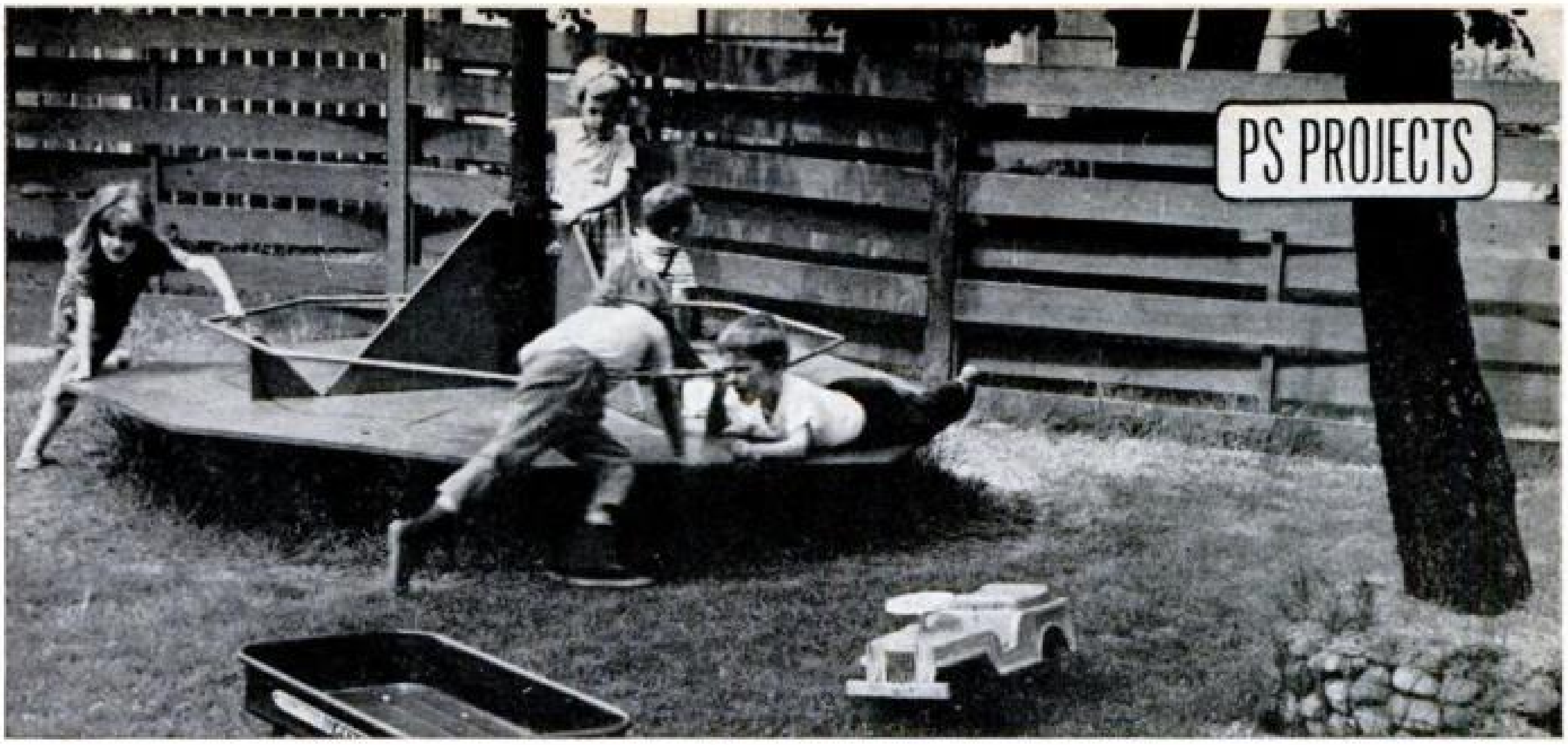


Back-Yard Merry-Go-Round

You get this fun machine out of plywood and a half-day's work

THIS whirlygig, spinning on a steel post set in concrete, is an amusement-parkful of fun for the kids—one sure to keep them in their own back yard. Make it from two 4′-by-8′ sheets of exterior (A-C grade) plywood, two 10′ lengths of thinwall conduit, and 4′ of steel lally column.

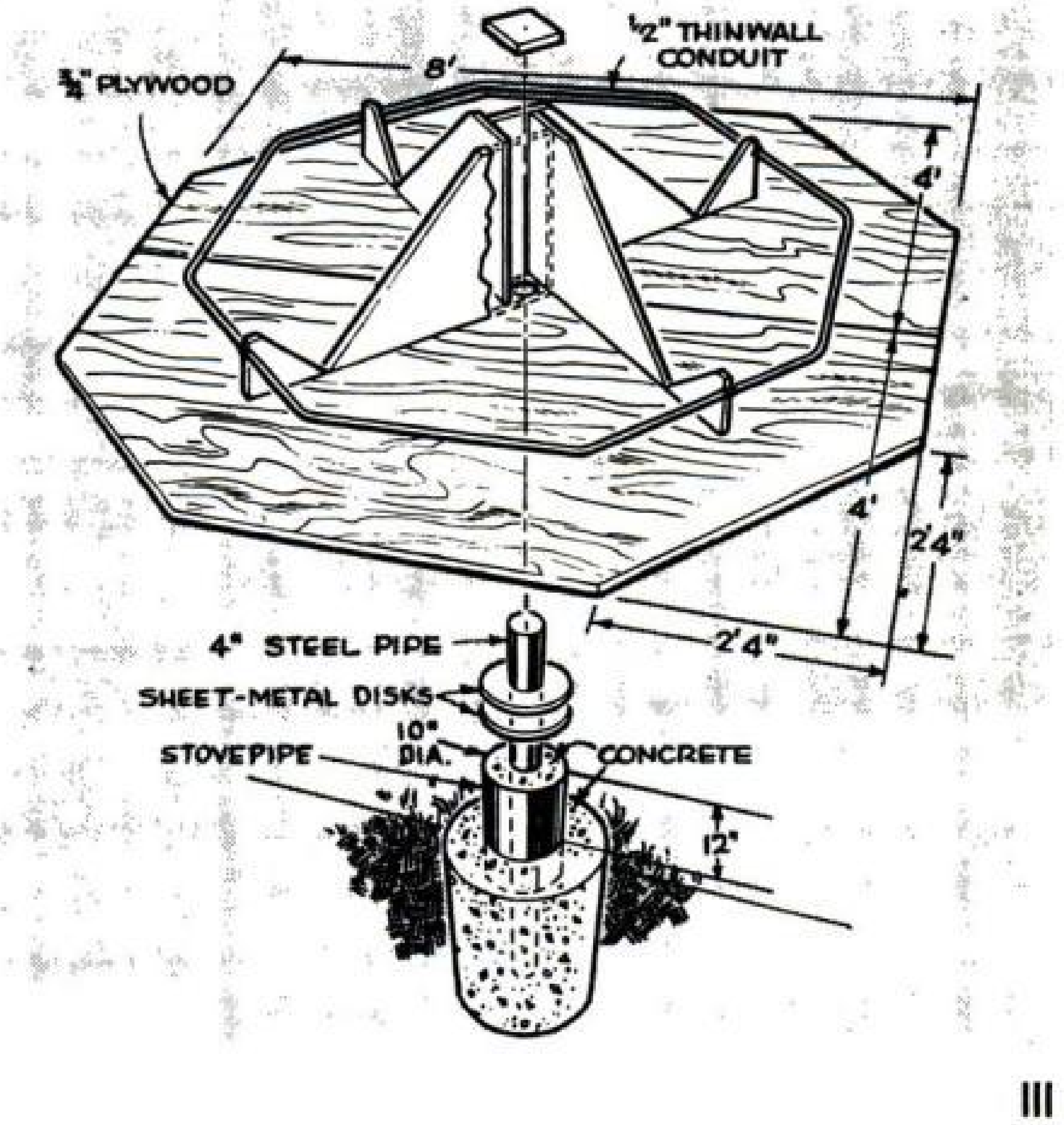
The platform is an octagon formed by cleating the two pieces of plywood together and sawing off the corners—used for the superstructure.

Cut a center hole 1/16″ bigger than the column, and assemble the superstructure for a snug fit around the column. Use waterproof glue and screws for all joints except the cap, which should be removable for greasing.

With a pipe bender, form the handrail, joining the conduit with a ½″ dowel held with screws. Mount it with regular conduit clamps.

To provide a bearing surface at the base of the column, use a piece of 10″ stovepipe filled with concrete. Above it, two disks of sheet metal, greased, absorb wear.

If you have an existing post in your yard—such as a clothesline support—anchored in concrete and strong enough to handle the merry-go-round, put the stovepipe around it and pour the bearing. Then build the project in two halves and assemble these around the post.—*Richard E. Londgren.*



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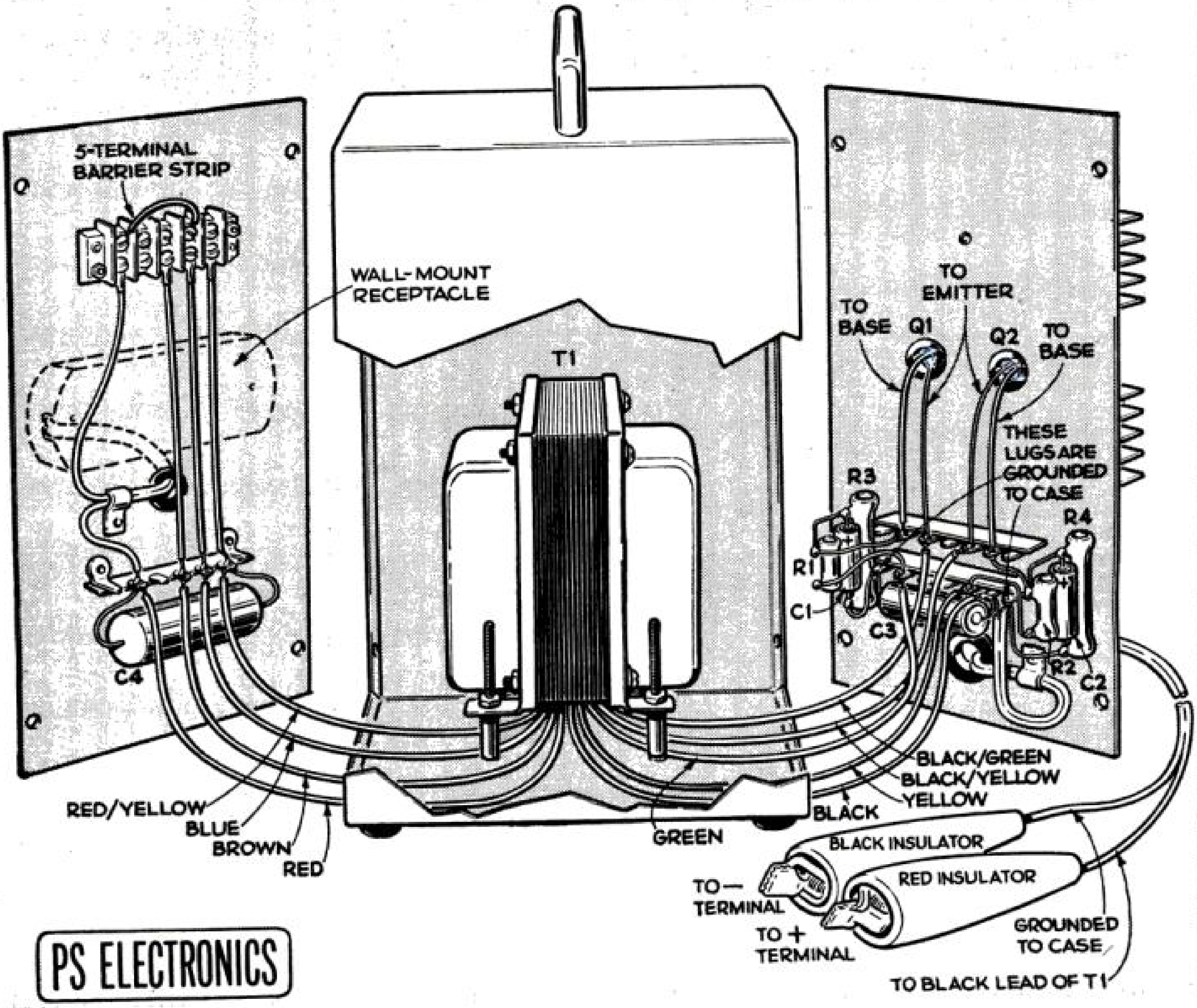

PS ELECTRONICS

Build your own

Wall Plug in the

It's a DC-to-AC "inverter"—12-volt battery current goes in; out comes 120-volt 60-cycle AC

By Ronald M. Benrey

WHY leave your most useful electrical appliances at home when you travel this summer? This easy-to-build DC-to-AC inverter will let you plug 'em in any place. Just hook it up to a 12-volt car battery; an efficient dual-transistor circuit does the rest. The inverter supplies enough AC to run most TV sets, small kitchen appliances, hi-fi gear, light-duty power tools—in short, any electrical equipment that draws less than 120 watts of AC.

How it works. The heart of the inverter circuit consists of a special transformer, T1, and two high-power germanium transistors,

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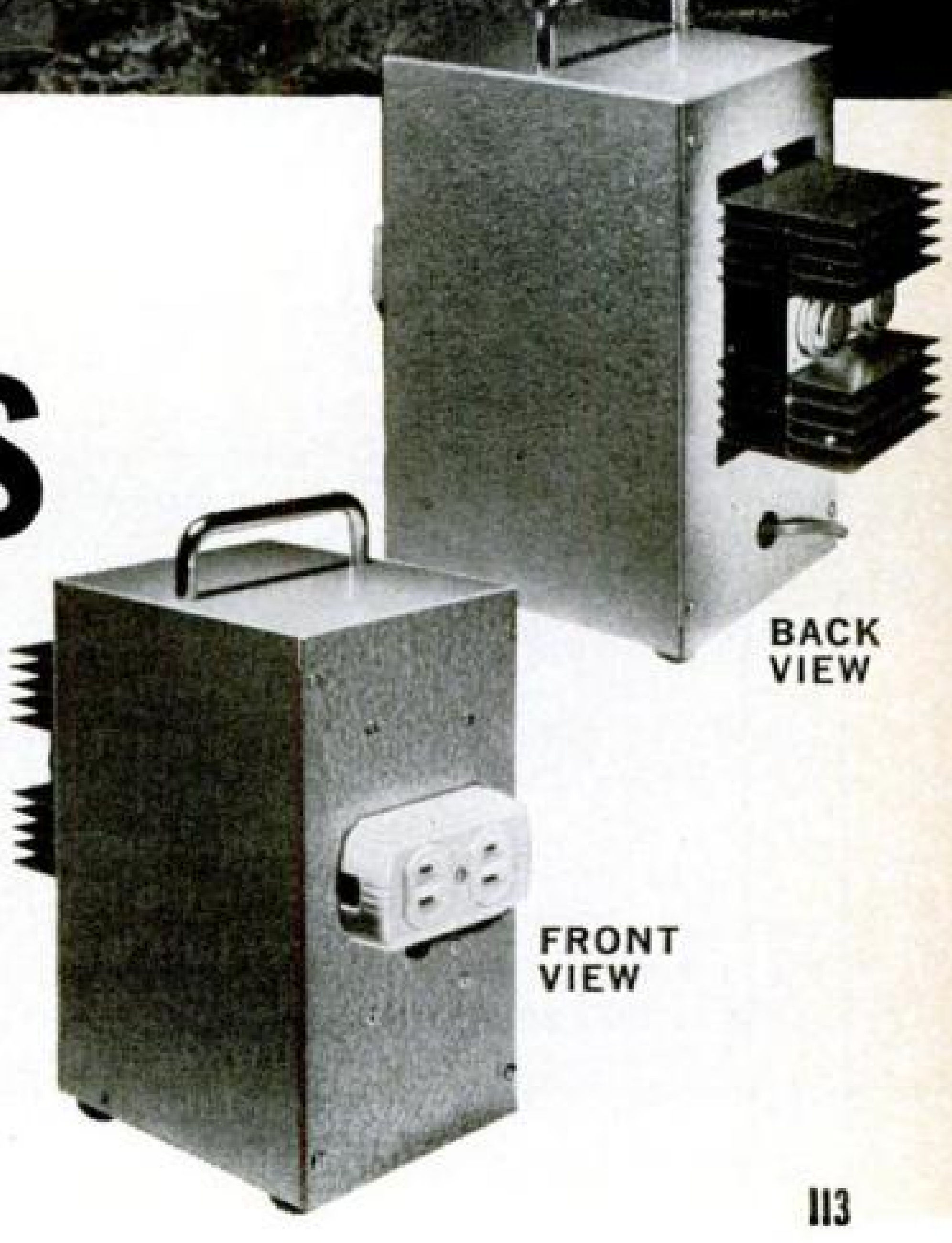
Wilderness



BACK VIEW

FRONT VIEW

Q1 and Q2. T1's primary windings and the transistors make up a battery-powered oscillator that generates low-voltage alternating current. T1's secondary winding boosts the voltage to about 115 volts AC.

The circuit oscillates at approximately 60 cycles per second—the frequency of ordinary house current. T1's core is specially fabricated to keep the oscillating frequency nearly constant, independent of how much power the inverter supplies.

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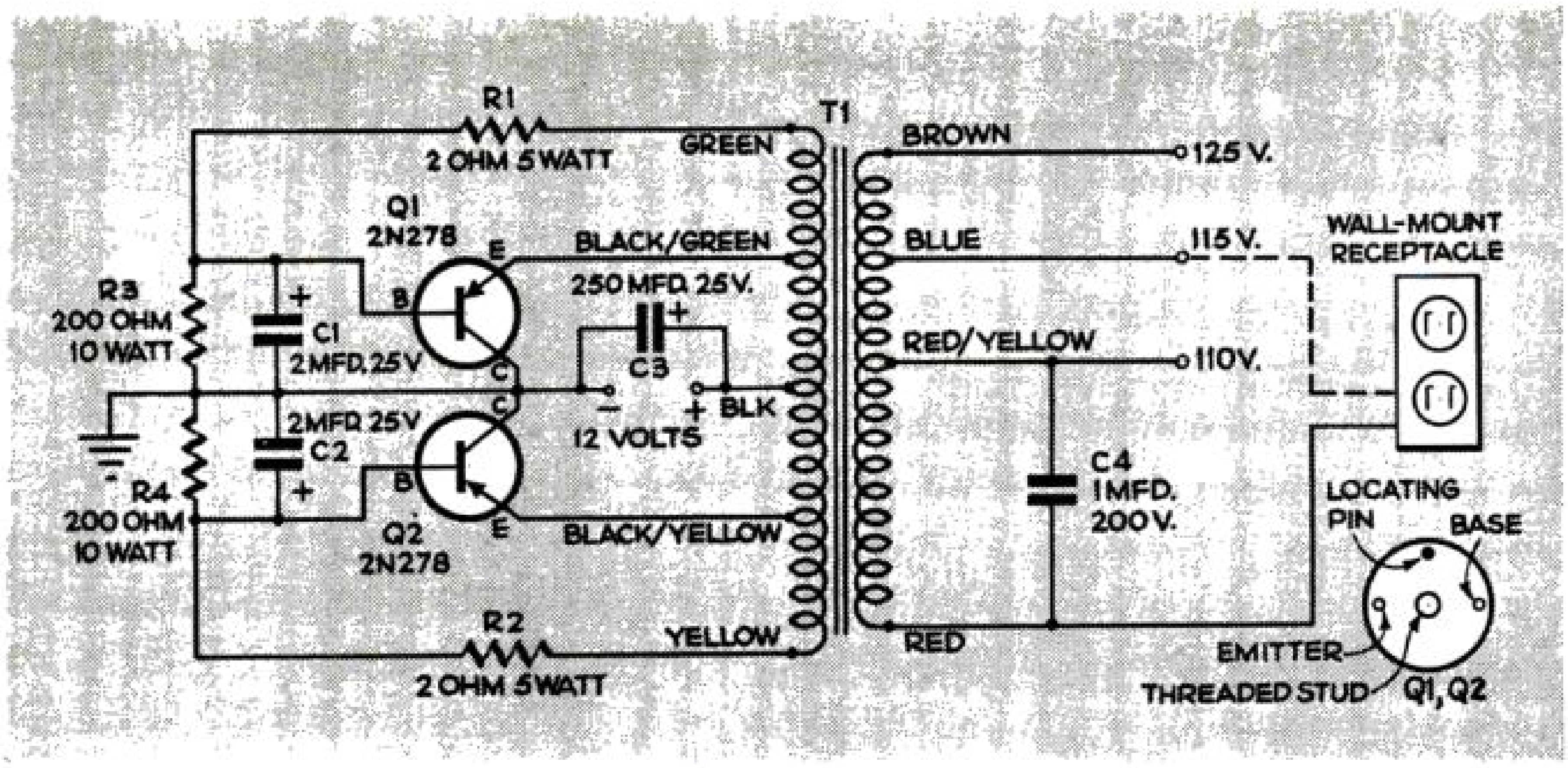


PARTS LIST

R1, R2—2-ohm, 5-watt wire-wound resistor
R3, R4—200-ohm, 10-watt wire-wound resistor
C1, C2—2-mfd., 50-volt electrolytic capacitor
C3—250-mfd., 25-volt electrolytic capacitor
C4—1-mfd., 200-volt paper capacitor
T1—Triad TY-75A inverter transformer
Q1, Q2—2N278 power transistor (Delco)
Heat sink—Delco 7281366 finned aluminum heat sink
Note: T1, Q1, Q2, and heat sink available from Harvey Radio Co., 103 W. 43 St., NYC 10036.
Misc.—Aluminum utility cabinet 6" x 9" x 5" (Premier PAC-695), terminal strips, alligator clips, wall-type AC power socket, barrier terminal strip

When the circuit is operating, Q1 and Q2 dissipate a good deal of heat, so they are mounted on a large, finned heat sink. Unlike most transistorized inverters, the transistors are wired in a "common collector" circuit. This simplifies assembly—their metal cases (collector terminals) are grounded directly to the heat sink; no special insulators are required.

Building the inverter. Start by mounting the major components on the removable front and rear panels and the center section of the aluminum utility case used as a cabinet. Place ½-inch spacers on T1's mounting bolts to provide clearance for its leads. Scrape away the black finish around the heat sink's mounting holes to assure good electrical contact with the aluminum case when it is fastened in place.

Make sure transistors Q1 and Q2 are firmly bolted to the heat sink before you solder the connections to their base and emitter pins. Don't overheat the transistors: Work quickly, using a hot, well-tinned iron. Use #14 tinned solid-copper wire to connect the emitter pins to T1; #16 wire for the other connections. The smaller components are supported by their leads—use terminal strips as soldering points. Double-check the polarities of the three electrolytic capacitors before soldering them in place.

Use #14 stranded, two-conductor cable to connect the inverter to a battery—keep the cable as short as possible, in no case over 15 feet. To use the inverter in a car, replace the alligator clips shown in the diagram with an accessory cigarette-lighter plug.

T1's secondary winding has three output taps; for convenience, all are brought out to a terminal strip. When the inverter is powered by a 12-volt storage battery, the taps supply 110, 115, and 125 volts AC respectively. To power most appliances, connect the output socket to the center—115 volt—tap.

Hints for using the inverter:

- Make sure the polarity is right when you connect battery cables to the battery—a mix-up could damage the circuit.
- Never connect the inverter to a battery unless an appliance is plugged into the panel socket (the appliance's on-off switch, if it has one, must be turned on before you hook up the battery leads). The inverter circuit can produce transistor-damaging voltage transients if it isn't supplying power to a load.
- Keep the inverter out in the open when it is operating—the heat sink needs air circulating around and through it to cool the transistors properly. ■■

Urheberrechtlich geschütztes Material

Personal-use report:

Garrard Lab 80 Automatic Turntable

YOU can team this automatic turntable with the highest quality hi-fi stereo components with complete confidence. I tested it using a Shure M55E pickup cartridge, a Dyna Stereo 70 amplifier, and a pair of AR3 speakers.

I found that a high-compliance cartridge like the M55E tracked perfectly at only one-gram force. This means you can play your stereo records indefinitely with almost no perceptible wear.

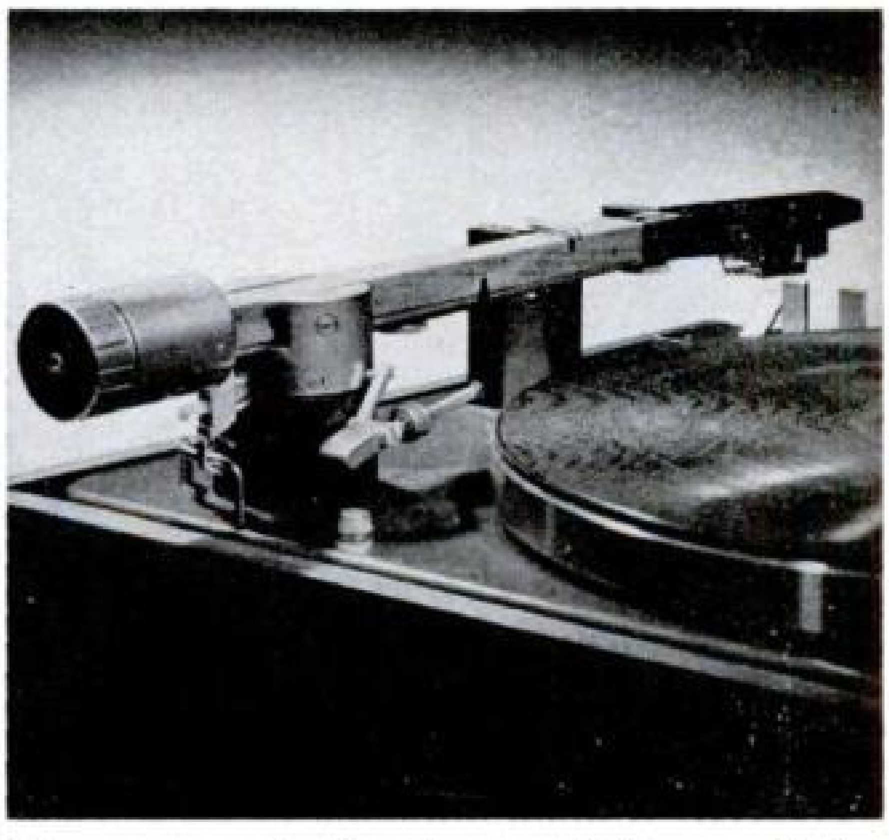
There are good engineering reasons for this remarkable performance:

- Tracking-angle error is less than 0.2 degree per inch over most of the record.
- The wood tone arm is counterweighted for balance, and tracking force is applied by a calibrated spring.
- Magnetic repulsion actuates the trip for change cycle—no mechanical contact.
- An ingenious bias compensator counteracts the side force inherent in any offset tone arm.

Rumble is less than with most professional turntables. It is inaudible with the AR3s pumping out enough volume to fill an auditorium. Wow and flutter are imperceptible even on sustained piano tones.

The Garrard Lab 80 Automatic Turntable sells for $99.50.—*Hubert Luckett.*

Fingertip tab controls select speed, manual or automatic operation, and record size. On manual, an automatic cueing control lowers the arm gently to place stylus in any chosen groove.



Bias compensator is a lever-weight-ramp device on the tone-arm pivot post. Ramp bears on pin fixed to pivot housing. Weight is adjusted in or out on lever to give proper outward thrust.

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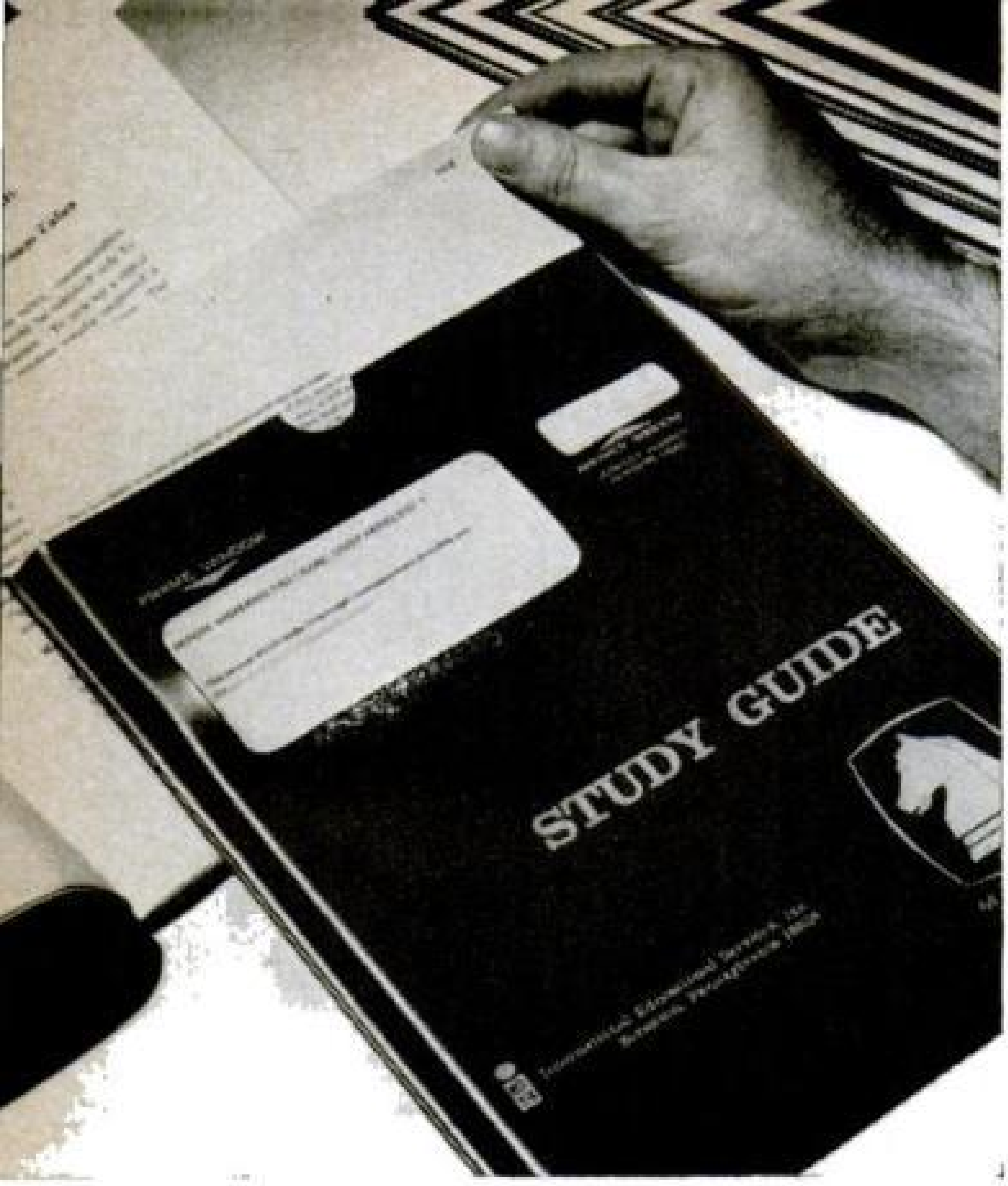

Personal-use report:

"Peek-a-Boo"

NOBODY has invented a sure-fire easy way to study electronics, but there are self-teaching methods that let you study more efficiently. One of the best I've seen is the new Study Guide series published by International Educational Services, Scranton, Pa., and available in schoolbook shops.

There are 18 guides on sale. Each costs about $4 and covers a specific electronic subject. The topics range from basic electron theory to vacuum-tube amplifier design. The guides are useful because they force you to focus your attention on one important

A Black Box That May Cure Color Blindness

HERE'S news for the 80 million color-blind people throughout the world. An electronic oscillator developed in Japan is reported to restore color vision by "training" the weak color-perceiving cells in the eye to see color. Researchers at Tokohu University found that weak color cells are stimulated by tiny, painless, low-frequency electric currents: 77 cycles per second for red; 42.5 for green (blue-yellow blindness is rarely found).

The patient wears a pair of temple electrodes—the circuit alternately generates three seconds of 77 c.p.s., and three seconds of 42-5-c.p.s. current.

Daily 10-minute treatments for six months are said to restore color vision. Sold in the U.S. by Sharp Electronics, Carlstadt, N.J.

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Packets That Teach Electronics

fact at a time; only when you understand it do you go on to the next fact.

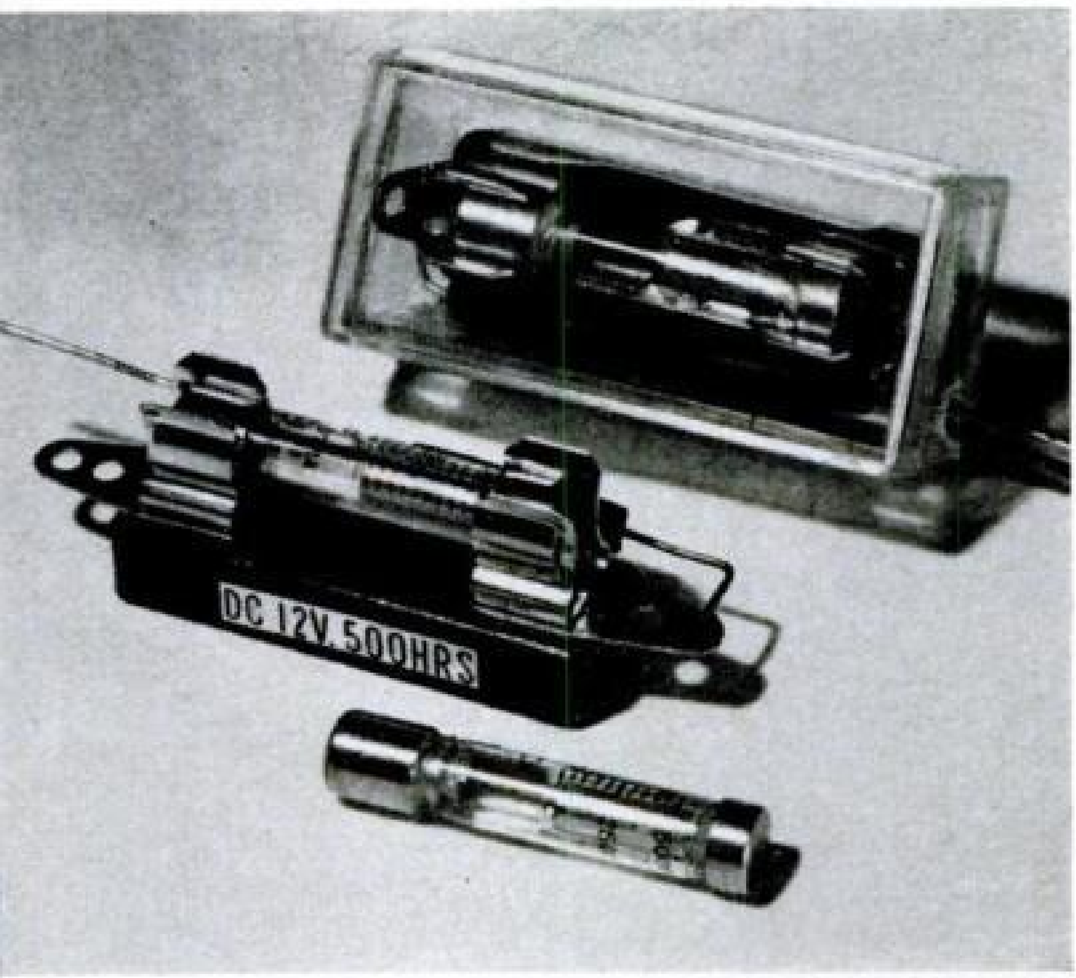
Each guide consists of a flexible plastic envelope that holds a pack of question-and-answer sheets printed so that when a question is visible through the large window in the envelope, the answer is hidden.

Before answering a question, you follow the directions printed above it, and read the specified paragraphs in the accompanying text booklet. This gives you the theory necessary to answer the question.

When you have decided on an answer, you check it by pulling the sheet slightly upwards: The correct answer appears in the little window.

My major criticism of the guides is that many of the questions are stated ambiguously: They have more than one "correct" answer. This can confuse, and may even discourage, beginners who don't realize their answer says the same thing as the printed answer, but in slightly different words.

The bulk of the questions, though, are well designed, and lead the student step-by-step through the subject material. One nice point: the booklets have brush-up sections on the math you will need.—*R. Benrey.*



Low-cost running-time meters

Wire one of these miniature electroplating cells in parallel with any electrical machine, and it indicates the machine's total running time. When power is applied, a tiny current flows through the cell and gradually plates a silver-colored coating on a calibrated copper electrode. Models for various AC and DC voltages sell for about $4. SELA Elec. Co., 545 West End Ave., NYC.

Miniature FM wireless mike

The device shown above is a self-contained FM broadcasting station: It will transmit everything its hi-fi microphone picks up to any conventional FM tuner. Range is 50 feet. Called the Consort, it frees stage performers and public speakers from the cumbersome cables required with conventional microphones. Price: about $40. Amphenol-Borg Corp., Broadview, Ill.

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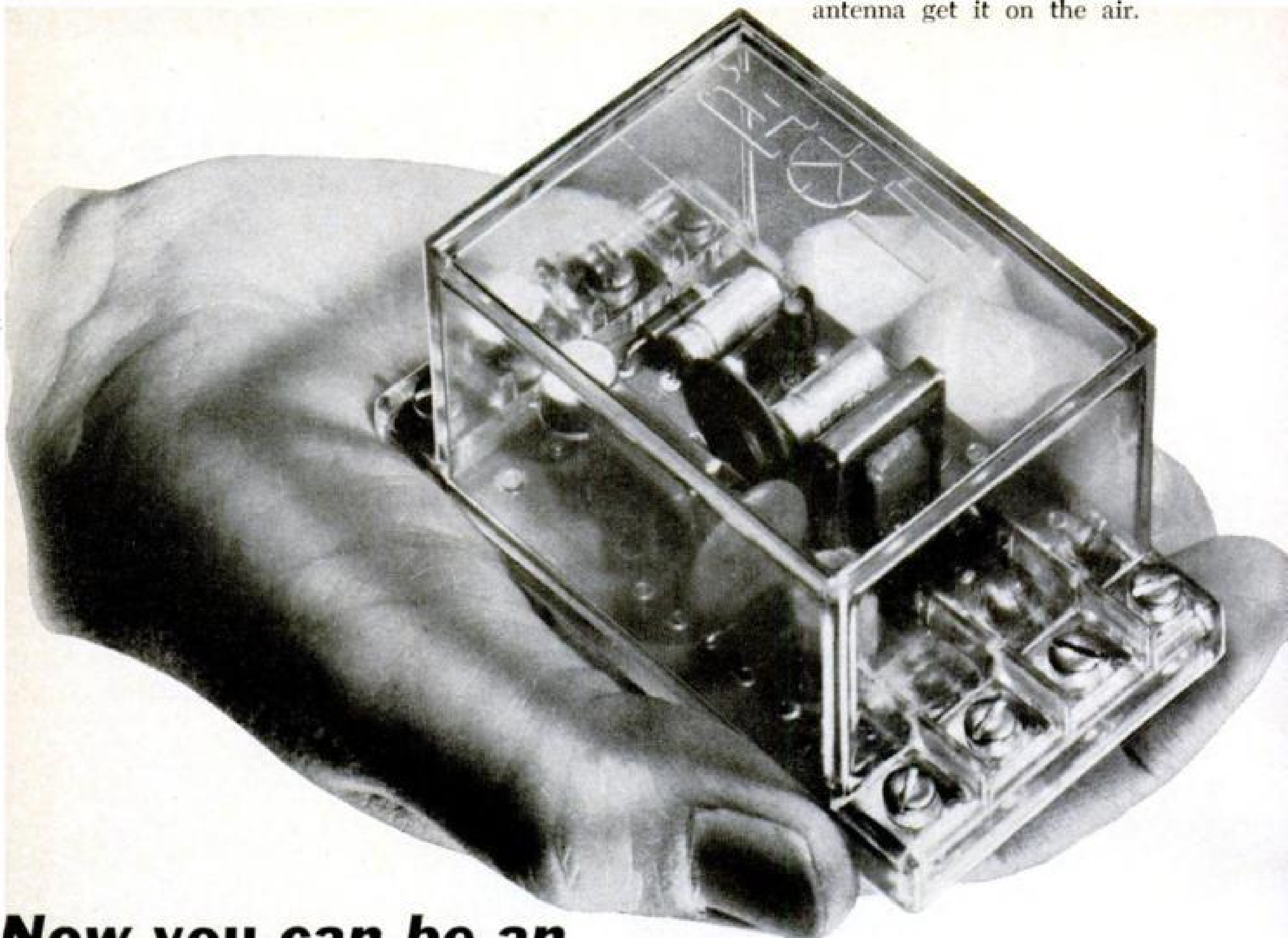
Plastic-cased palmful is a transistorized radio-control transmitter circuit. A battery and antenna get it on the air.



Now you can be an electronics expert with these—

PreFab Electronic

By Ronald M. Benrey

IF YOU own a screwdriver, and if you know how to use it, you can put together dozens of useful electronic devices. The secret is a brand-new family of prefabricated electronic circuits called IRectronic modules. They are made by the International Rectifier Corp., El Segundo, Calif.

The modules make building a complex project as easy as wiring a doorbell; you needn't know a thing about electronics.

First, choose a project. Here's a partial list of what you can build:

- Short-range public-address systems, both hand-held and fixed-installation models.
- An electronic baby-sitter that lets you listen in on the nursery from another room.
- An electronic metronome.
- An all-purpose photocell electric eye that can be used to trigger an alarm, to announce people passing through a doorway, or to light a table lamp in the evening.
- Both wireless and conventional wired home intercom systems.
- An AM-FM radio.
- A Citizens Band walkie-talkie.
- A boat signal horn.
- A remote photoflash slave unit.
- A hand-held loud-hailer.

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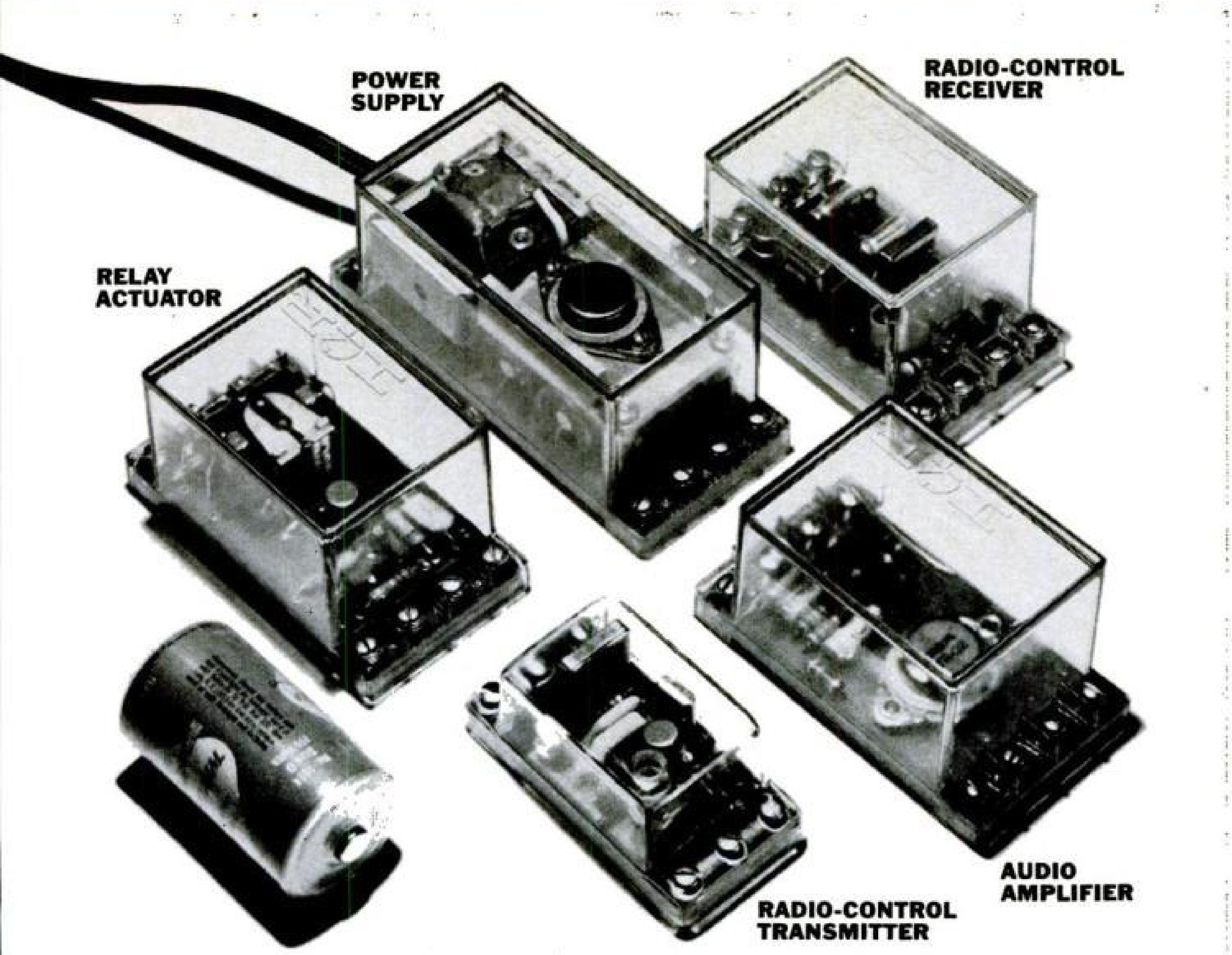

IRectronic circuit modules come in 25 versions. Five are shown here. Resemblance is only skin deep: Each one of them has a different transistorized circuit wired on a printed board.

Building Blocks

• An all-purpose radio-control transmitter and receiver system.

Next, follow the simple instructions—it's like painting-by-numbers—and wire the proper modules and accessory components (plugs, speakers, volume controls, etc.) together. There's no soldering—all connections are made to screw-type terminal posts molded into the modules' ends.

Finally, hook up the power supply. You can use a special AC-operated power module, or any six-volt battery. That's all there is to it.

Even if you make a wiring error (which is not likely) you can't damage anything: The modules' fully transistorized printed-circuits are designed to be burnout-proof.

The circuit modules for carry-around projects—such as the photoflash slave (shown on the next page)—have specially formed plastic cases that snap onto the top of a convenient portable battery pack. It holds a conventional six-volt lantern battery.

For fixed-installation projects—such as the home intercom—there's an accessory plastic cabinet to hold the modules and other components. It keeps the wiring hidden, and gives a professional look.

What about price? Individual modules range from $4.95 to $19.95; total cost of a module project is about as much as an equivalent ready-built device. For ex-

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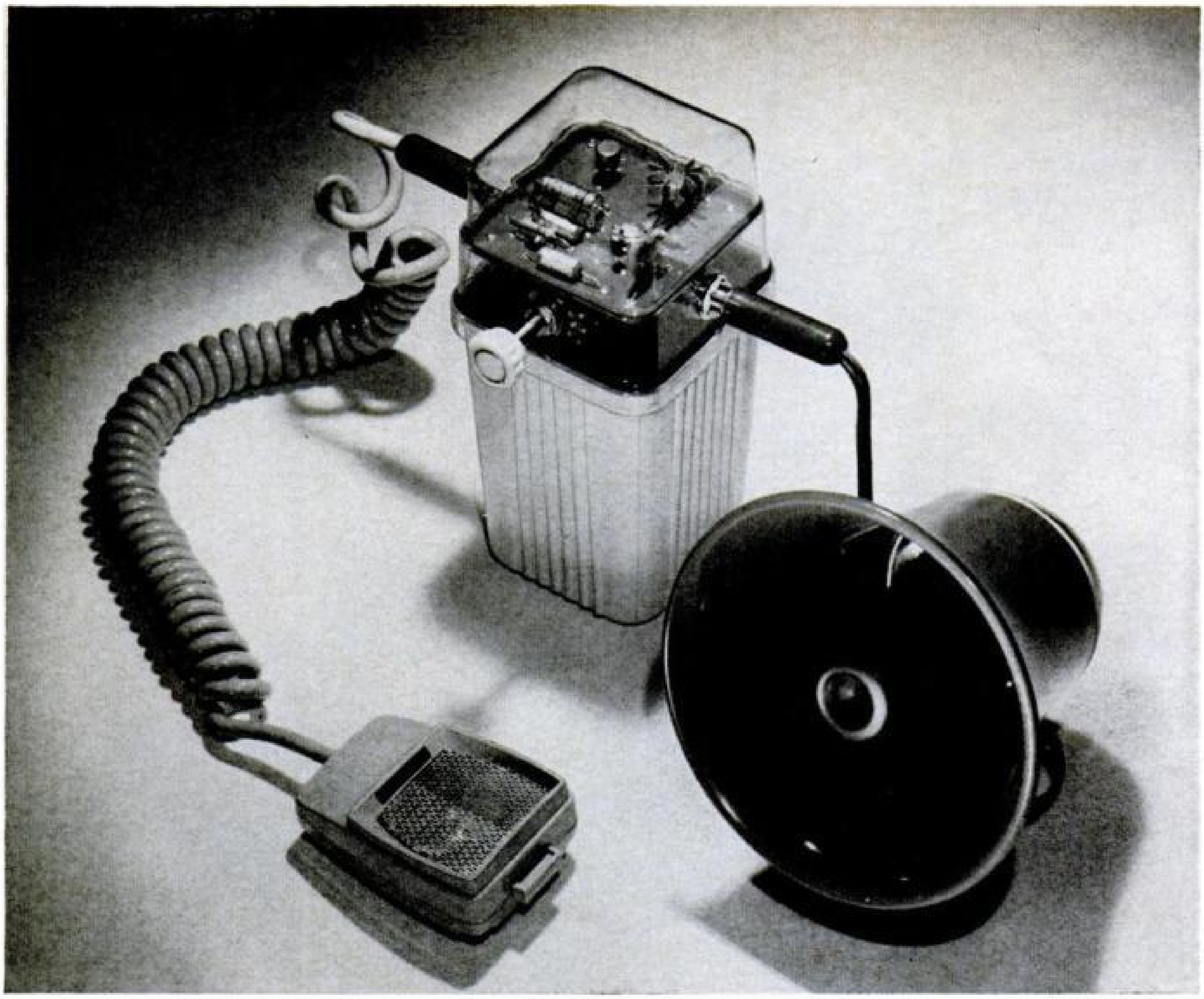

Battery-powered, hand-held public-address unit has a usable range of about 500 feet. The circuit board is inside the clear-plastic case which is mounted on white battery pack.

Battery pack holds a conventional six-volt lantern battery. It's universal—the pack will power both the PA-system module (left) and the photoflash slave module (foreground).

ample, the bill for a home intercom, with one master and two remote stations, is about $45. The modules aren't wire-it-yourself kits—they are fully wired and tested circuits; that's why you don't save money, even though you assemble them.

Building-block design is very flexible. It's easy to modify one of the basic projects while you are building it, or at a later time. For example, by adding an FM-tuner module to the home-intercom circuit, you create a home background music system. Or by adding an amplifier module and microphone to the boat-signal-horn circuit, you make it into a loud hailer.

Modular construction makes it child's play to service a project if something goes wrong. Just disconnect the faulty module and return it to the maker for repair.

And, of course, the projects can be assembled in minutes by even the most inexperienced, making them perfect first projects for anyone getting started in electronics. ■■

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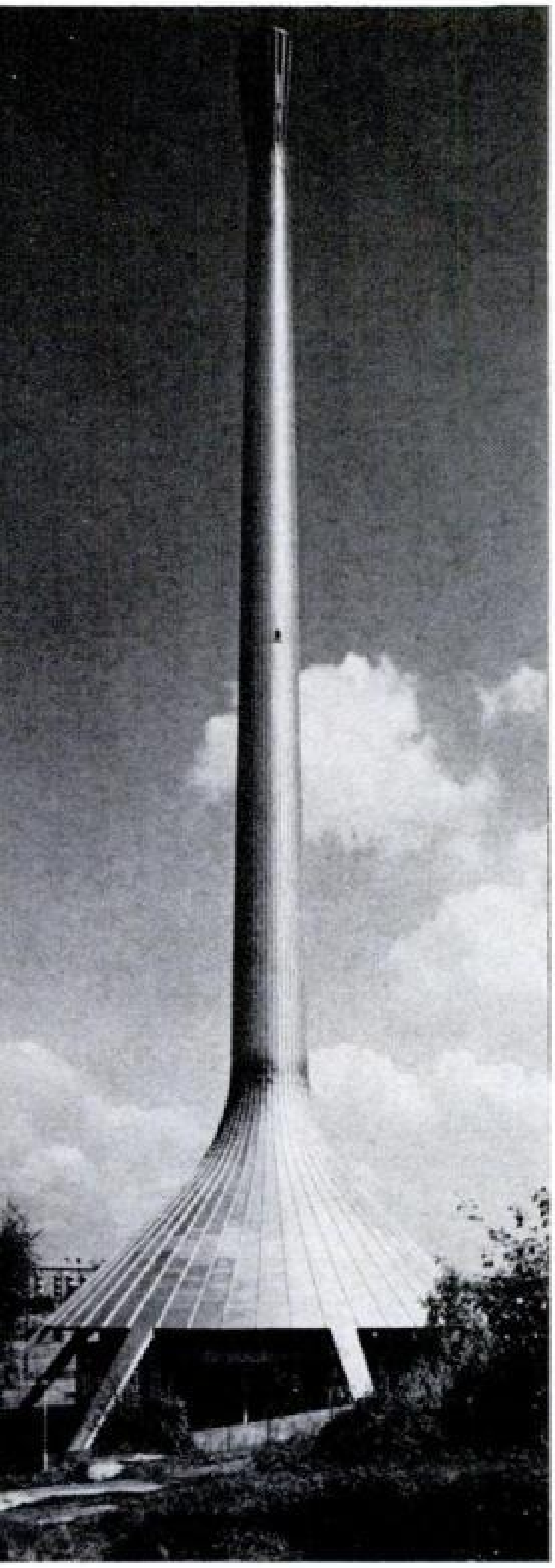
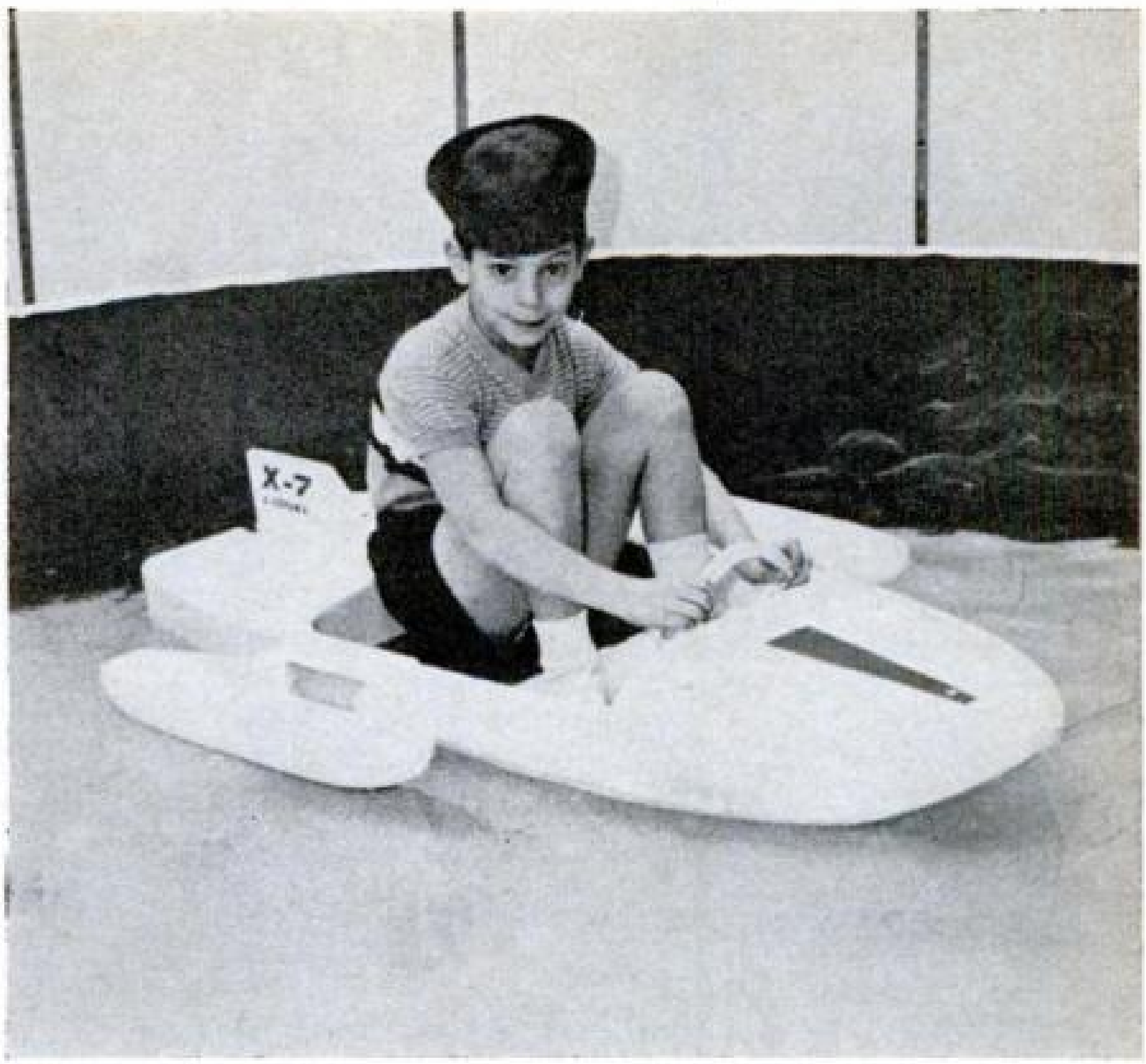


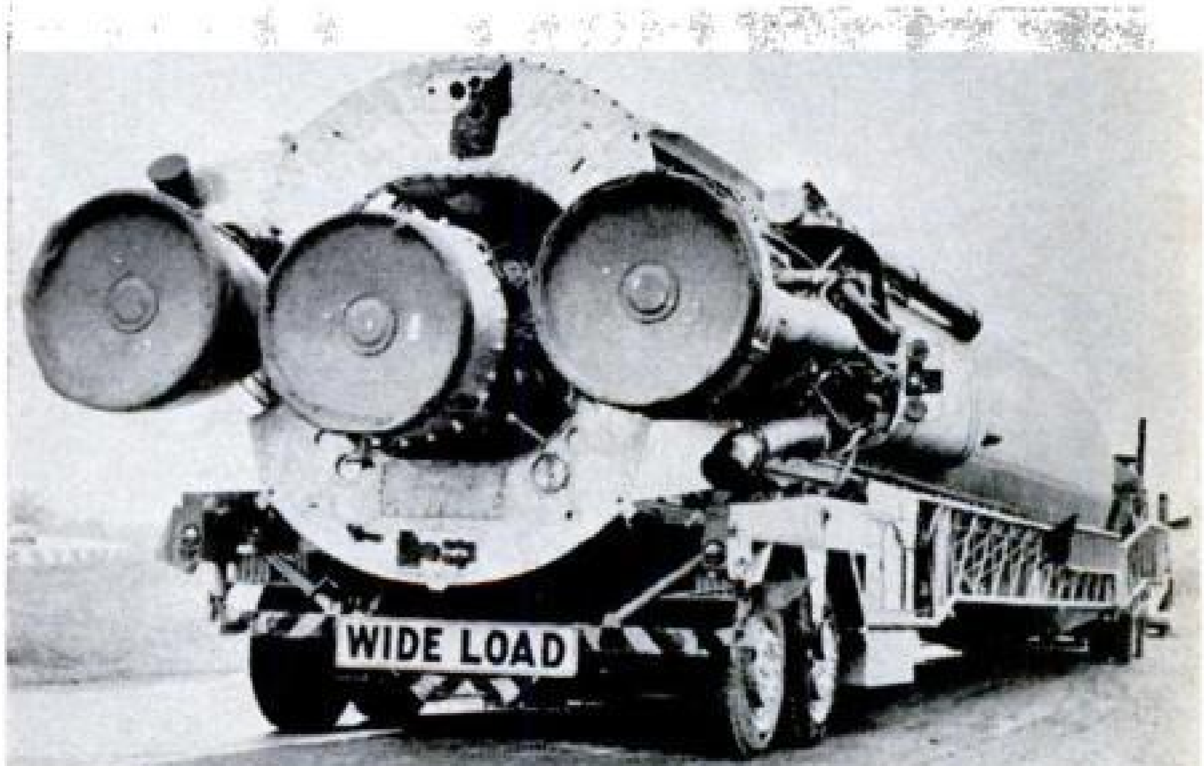
Shining smokestack is 235 feet high

Aluminum cladding on this 235-foot Swedish chimney keeps appearances up, heat losses down. Erected over a central heating plant for an apartment development in Vastra Froluna, a suburb of Gothenburg, its frame is cast aluminum. Outer plates encase insulation to reduce cooling of fumes and lessen air pollution; corrosion-resistant skin stays bright.



Child's outrigger motorboat for back-yard pool

Four feet long and of shallow draft, the little motorboat above can navigate in 5½ inches of water. Made of sturdy plastic, Lionel's X-7 is equipped with outriggers to prevent tipping in deeper water, has an over-ride clutch that disengages the steering wheel for added safety on sharp turns. The craft is powered by two six-volt batteries. It's small enough to carry in a car trunk.



Continental trucking for intercontinental missile

On a long coast-to-coast trek, this big Atlas intercontinental ballistic missile rides by highway to Norton Air Force Base in California where it was assigned when the missile bases at Plattsburg, N.Y., were closed this year. Twelve 10-foot-diameter, 100-foot-long missiles were hauled on special trailers. Traffic was rerouted on many of the highways for the trip, due to end July 1.

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New Ideas from the Inventors

Meter collects parking fee. Moving a lever on this recently patented parking meter would start a fee-calculating timer, lower a "vacant" flag, and raise a metal locking bar behind a car's front wheels. When you were ready to leave, you'd deposit the amount of money indicated on the meter dial. This would lower the bar, reset the flag, and light a back-up warning blinker for other cars.

Bike cab beats traffic. This one-passenger taxi, built onto the back of a motorcycle, might make riding faster than walking through downtown city traffic. It should be more economical, too, for the single rider. He would sit facing backward inside a compact enclosure on a seat fitted over the rear wheel of the motorcycle.

Edge rollers wheel suitcase. Nearly concealed in the corners of a suitcase, these wheels would let you roll a loaded case easily yet store or handle it like ordinary luggage. The relatively large-diameter wheels would ride more smoothly than small, external casters but would not have to steal much interior packing space.

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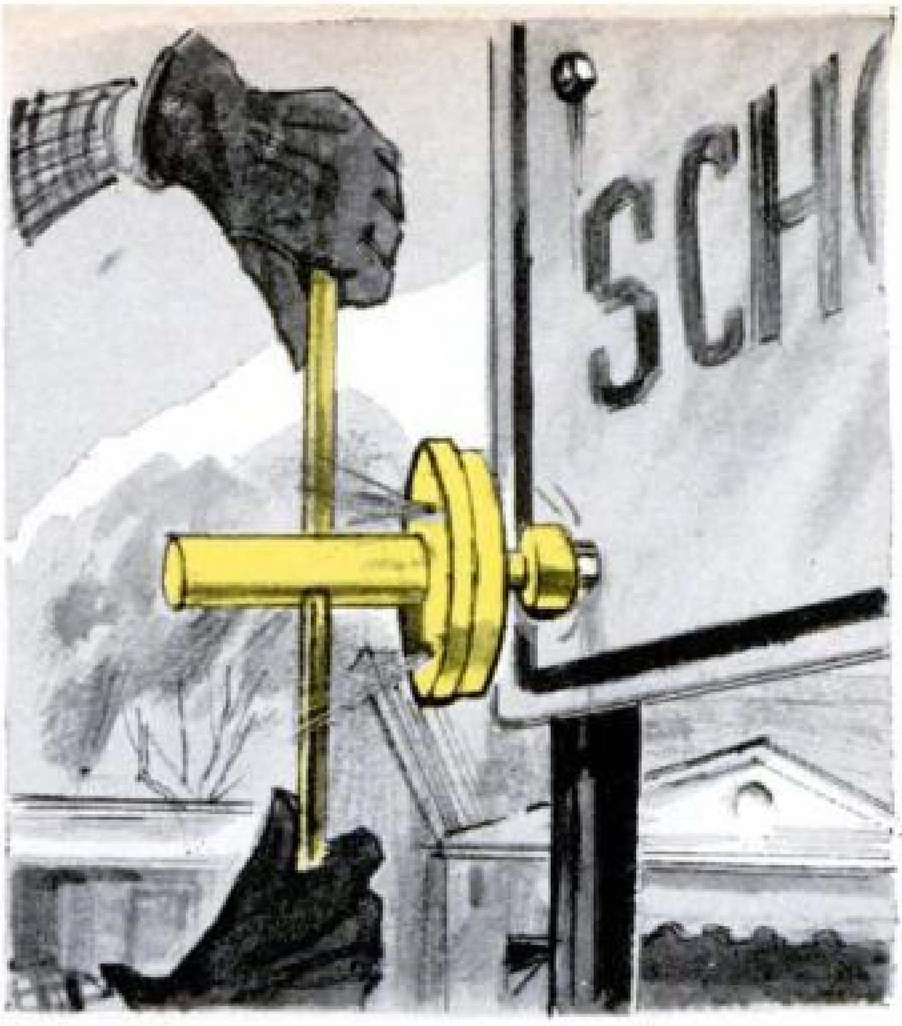

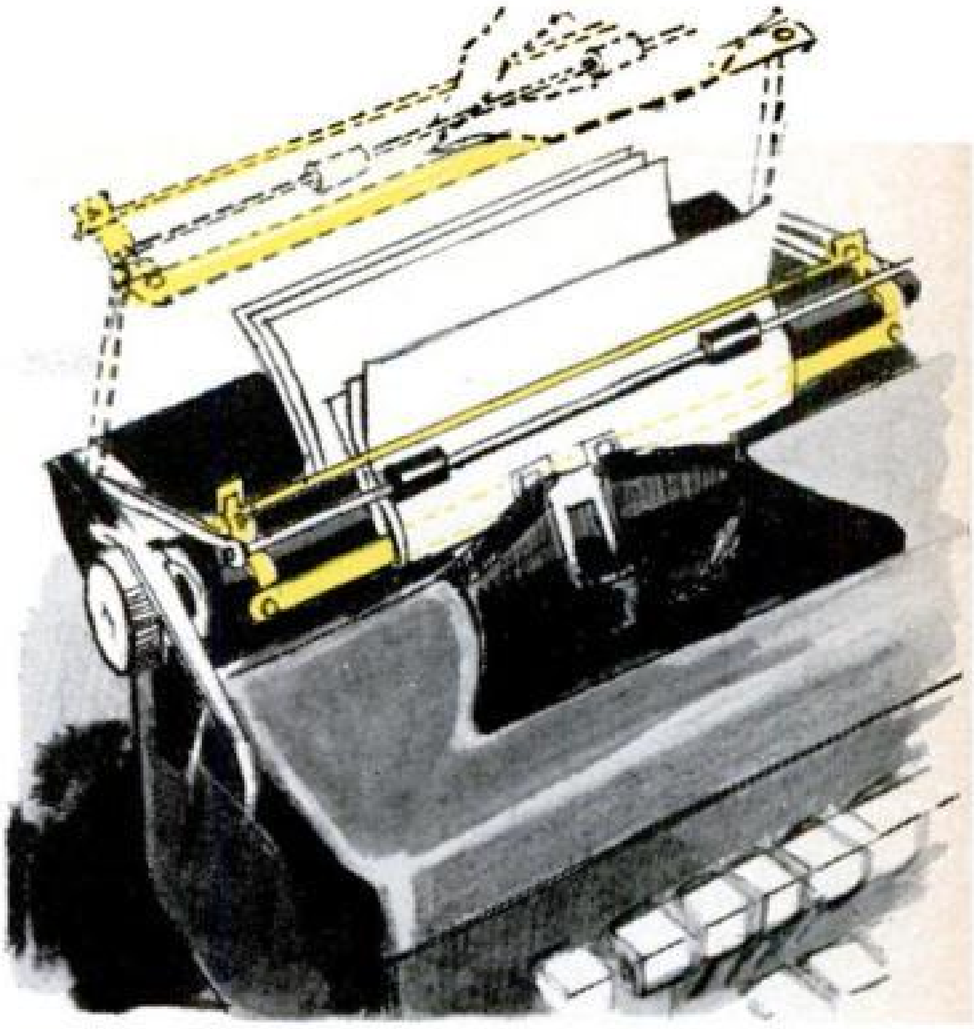

Cartridge wrench frees nut. The sharp, powerful twist of this explosively actuated wrench might loosen rusted or frozen bolts quickly and without the need for electric or air-powered equipment. Similar to cartridge-operated riveting guns, the wrench would direct a blank cartridge's charge against a torque-producing vane.

Extra ribbon types extra copies. You could make three typed copies at a time without carbon paper by clipping this extra-ribbon holder to the paper hold-down. The extra ribbon, between second and third sheets, would produce one regular sheet and one read-through copy (on the back of the transparent second sheet).

Trailer doubles as houseboat. You'd camp comfortably on land or water in a wheeled caravan like this with let-down pontoons. The pontoons would be hinged to the walls to swing either way. Separate deck planking would fit—and help lock—the pontoons in float-down position and would hold a support for an outboard motor.

The following patents have been issued on these inventions: **Parking gate**—*No. 3,161,275 to J. J. Sullivan, Norfolk, Va.;* **Bike cab**—*No. 3,164,396 to T. M. Morris, Ridgefield Park, N.J.;* **Suitcase roller**—*No. 3,163,268 to C. Leavell, Lombard, Ill.;* **Cartridge wrench**—*No. 3,129,-619 to R. A. Harrison, Washington, D.C.;* **Typewriter-ribbon attachment**—*No. 3,159,264 to Beulah L. Henry, NYC;* **Trailer boat**—*No. 3,090,975 to Alfred Bernard Franks, Gladesville, N.S.W., Australia.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington, D.C. 20231, at 25 cents each. To write to an inventor, if the address above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.

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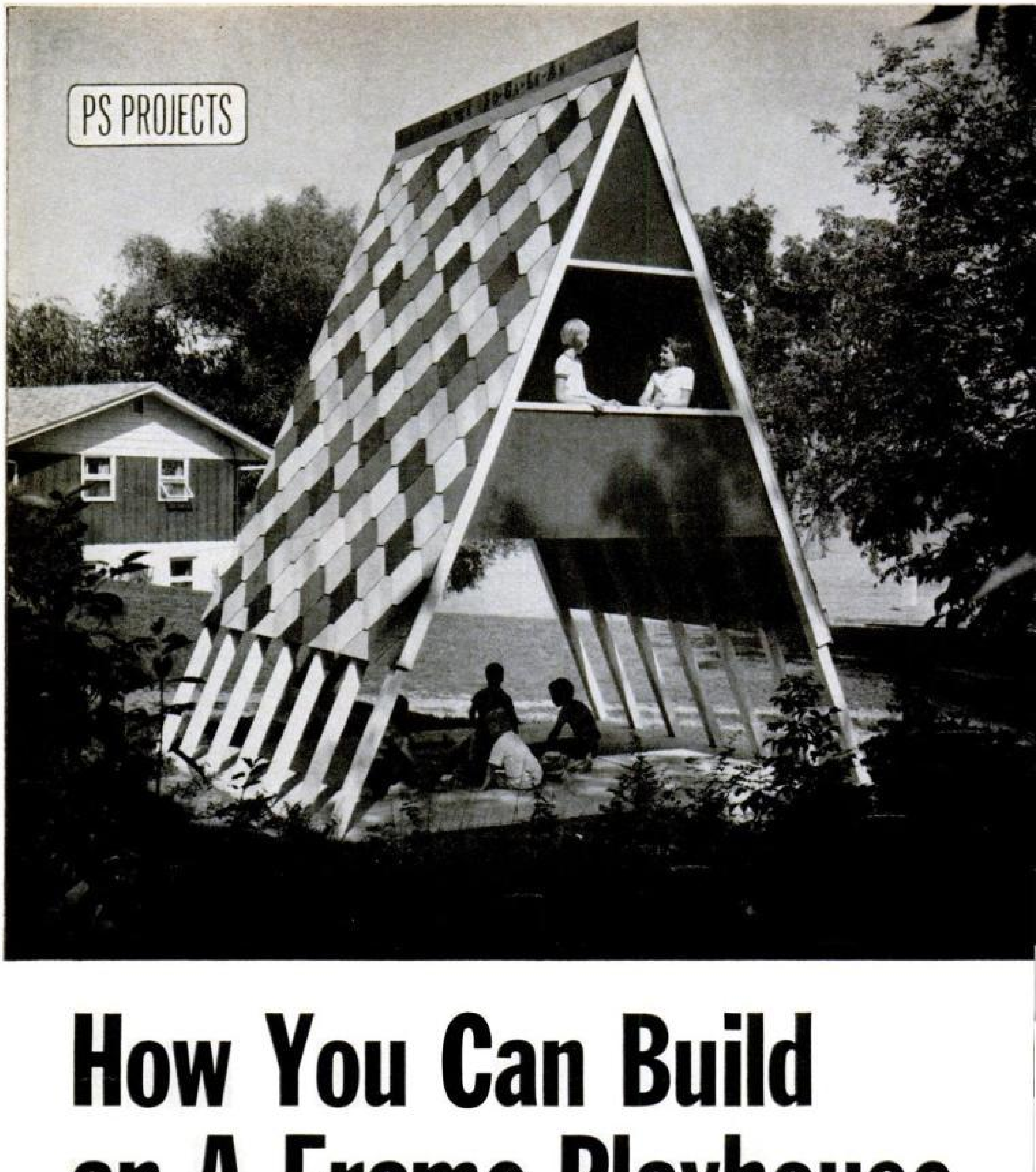

How You Can Build an A-Frame Playhouse

You're under roof in a weekend—and the kids can move in while you put on the finishing touches

By Ralph S. Wilkes

IF YOU can spare 12 by 14 feet of yard space and a couple of weekends, here's a playhouse every kid in the neighborhood will enjoy. Carroll Daniels of Penn Yan, N.Y., built it for his grandchildren for about $200. You could do it for less.

Features: an undercover sand pit with a concrete apron that's great for the steam-

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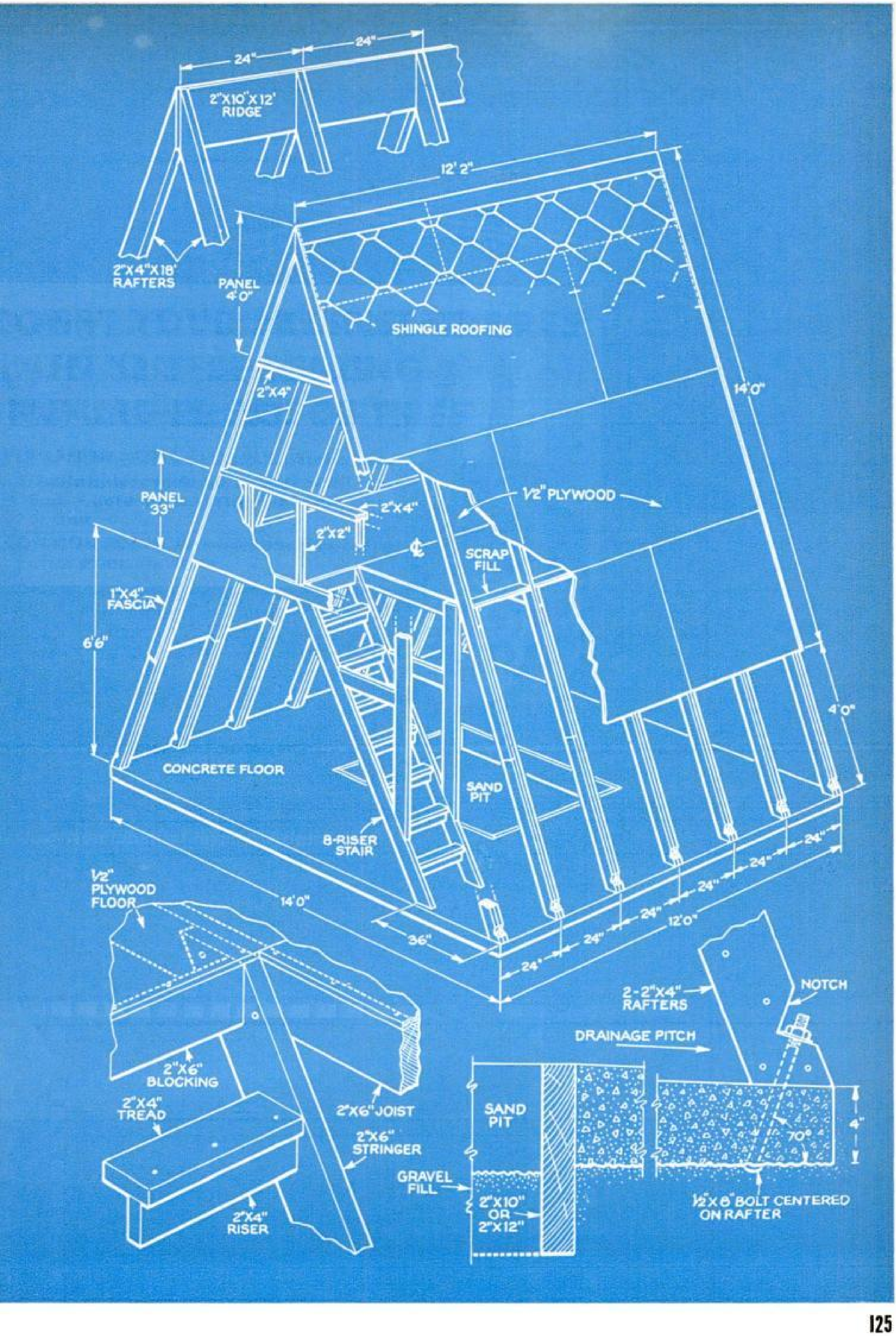

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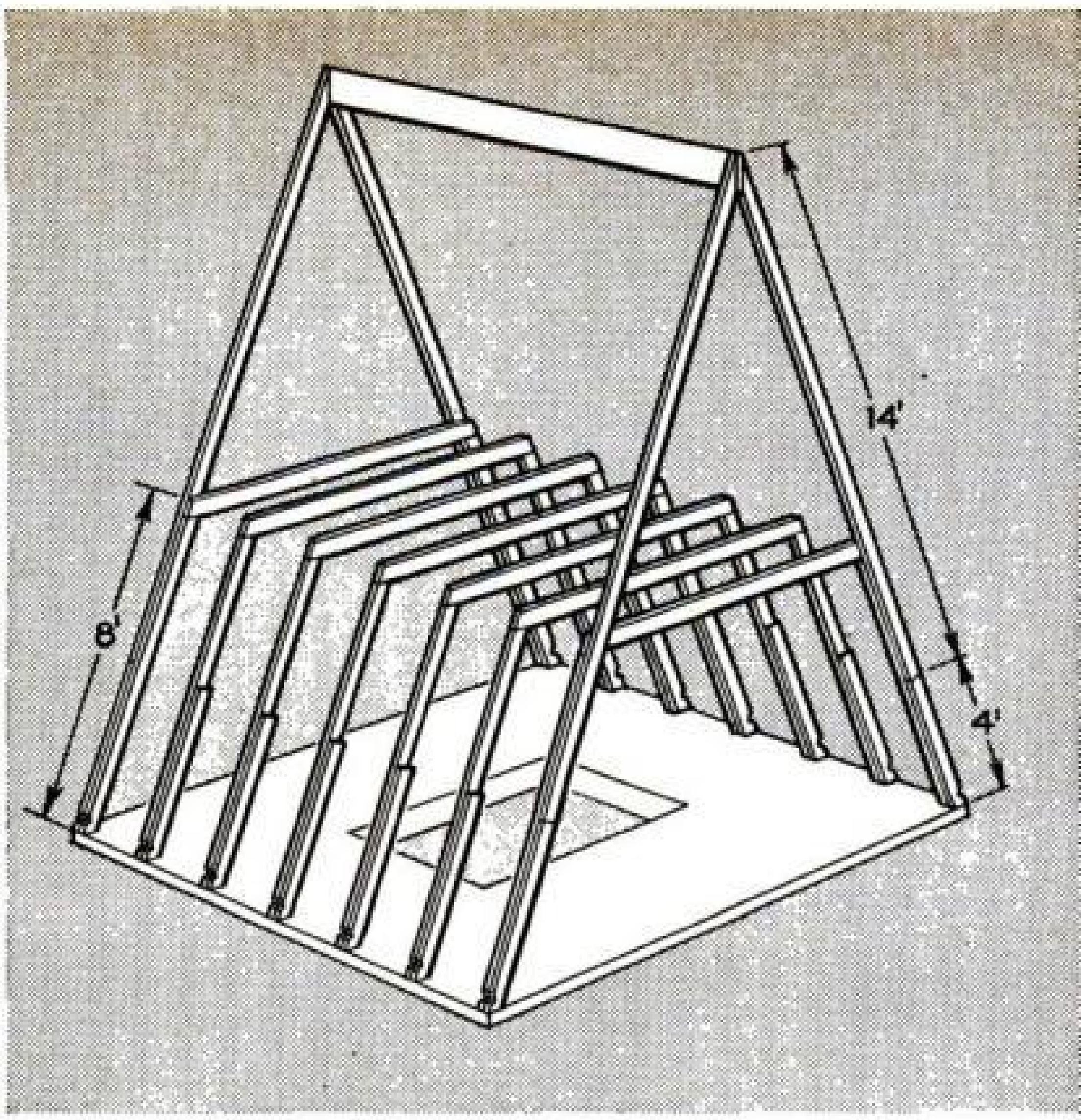

The two-stage method of A-frame construction is simple for one man. The heaviest member you handle is a 14′ two-by-four. For the first stage, spike the 4′ two-by-fours to the eight-footers, cut the notches, and drill the holes for the anchor bolts. Stand these units up and bolt them in place. Then lay the two-by-six floor joists across the tops of the eight-footers and tack them in place. Next use a pair of C clamps to hold one of the end 14-footers in place while you spike it to the eight-footer and to the joist. Put up another rafter on the same side and nail up the purlin. Complete the two end A members, and from there on you'll find it easy going.

shovel set and an 8′-by-12′ second-story room, ideal for a doll-size nursery.

Begin by leveling the area and spreading about 4″ of crushed stone or gravel for drainage. Then set the forms as shown in the drawing. Since the two-by-twelves around the sandpit stay in place as a liner, treat them with a wood preservative.

You'll need about two yards of ready-mix for the job. To make it permanent, use steel reinforcing rod or mesh. Position the seven bolts carefully along each side, 2¾″ in from the edge on 24″ centers, with the end bolts 1⅝″ in from the end. Be sure these bolts are undisturbed until the concrete sets hard. This is simple concrete work, but you may prefer to farm it out.

You need seven A frames made of 18′ two-by-fours. To provide extra strength, spike an 8′ two-by-four to the lower end of each 18-footer. The top of this piece also provides a rest—cut to the proper angle—for the two-by-six joists. Fully assembled A frames are heavy; you'll need a neighbor to help you stand them up. However, one man can build them in two stages, as illustrated in the sketch above.

Keep the A members plumb with diagonal braces until you get most of the sheathing on.

The roof is ½″ sheathing-grade plywood laid with the best side down—since it becomes the interior of the house. Begin at a point exactly 14′ down from the ridge and sheath from the bottom up. At the top you'll use a strip 2′ wide.

Fill in the ends with exterior-grade plywood or hardboard. Provide a two-by-four horizontal or vertical stud wherever there is an edge that has to be nailed.

You can use roll roofing for economy, but it is hard to put up on such a steep pitch, and it is not as attractive as strip shingles. Those shown in the photo are leftovers of several different colors. They were cheap to buy and they give a Disneyland effect. Use regular roof cap, or improvise at the peak with strip shingles.

Put down the second floor, using exterior plywood. Leave a 48″-long opening between two joists for the stairway.

As described here, the A frame is entirely functional with the framing exposed. But if you wish, you can add trim before you paint it the bright colors a well-made playhouse deserves. ■ ■

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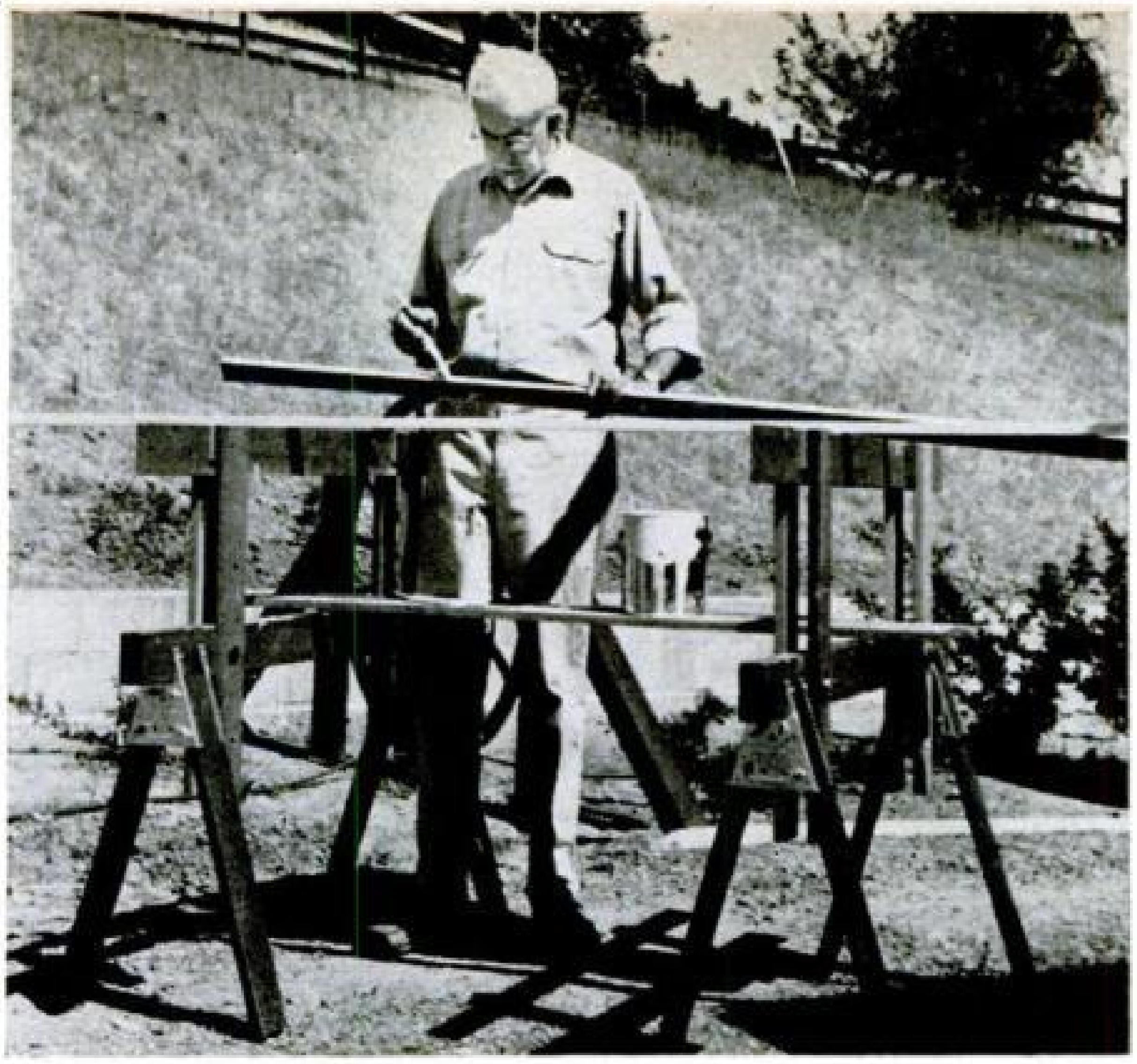
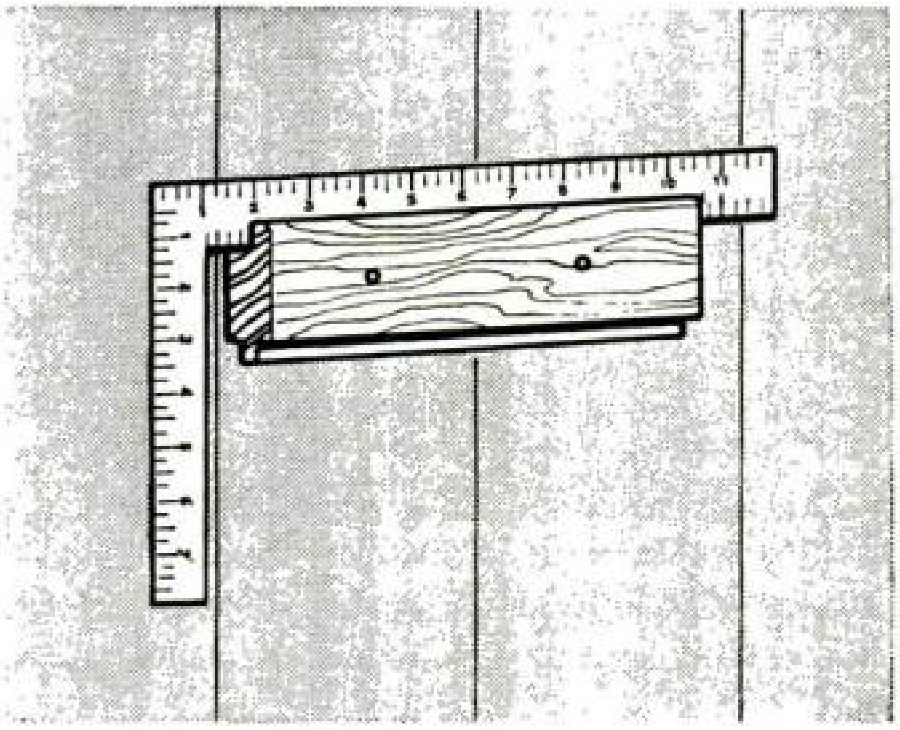


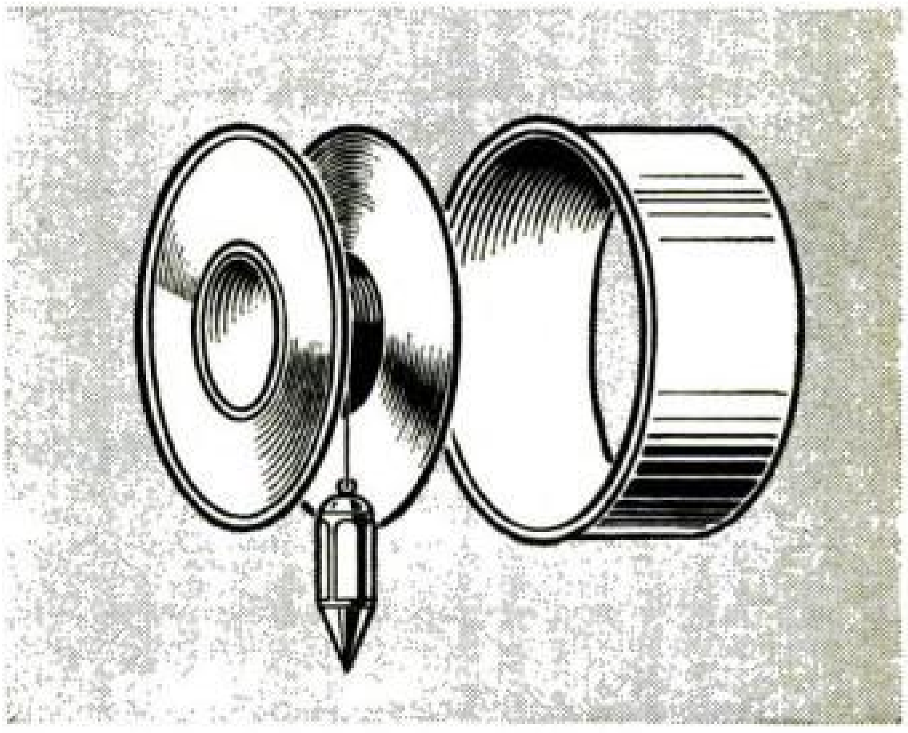
Sawhorses adjust to comfortable working height

For work on screens, windows, and other large flat projects, try this sawhorse attachment. One-by-threes at each end support a one-by-six crossbeam. Quarter-inch holes at intervals through the one-by-threes and sawhorse crosspiece let you move ¼" bolts to set height. Shim the attachment's one-by-six to match thickness of the sawhorse crosspiece.—*J. W. Clement, Healdsburg, Calif.*



How to rack a steel rule neatly

In most shops a nail in the wall does the job of supporting a steel rule, but a neater method that cannot nick the edge of the rule is to nail up a piece of tongue-and-groove flooring. The rule fits nicely in the groove.—*D. Bousha, Jackson, Mich.*

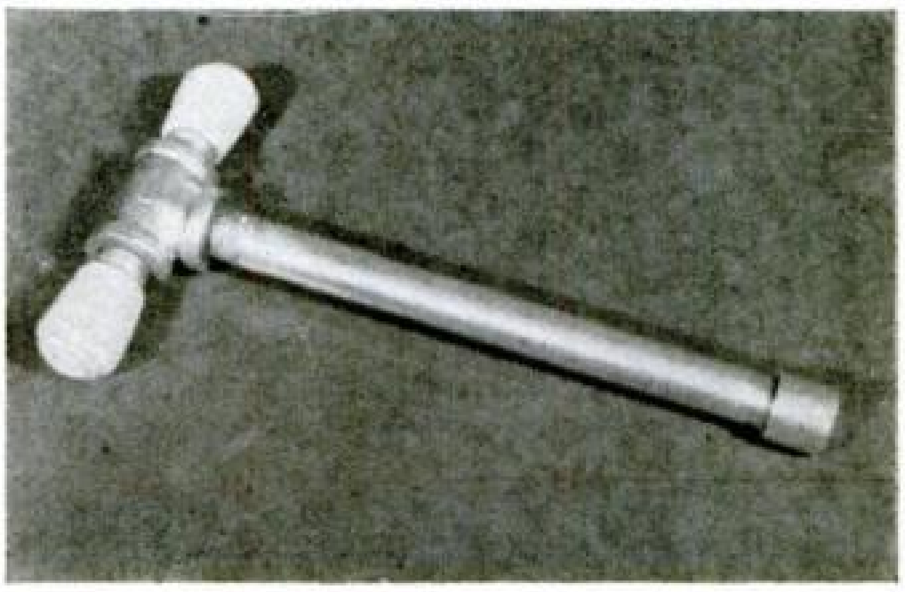


Storing a plumb bob and line

An adhesive-tape spool with cover is perfect for storing a plumb bob. Tie the free end of the line to the spool, wind up the cord, snap the cover closed. In use, snap on the cover to hold the line at any desired point.—*D. Bousha, Jackson, Mich.*

Crutch tips soften hammer blows

You can make a superior soft-head hammer for about a buck. Materials: an 8" length of ⅜" pipe, threaded at both ends, two 1½" threaded nipples, one tee, one cap, and two crutch tips. Assemble as shown at right, with crutch tips slipped over the nipples. For heavier work, cap the nipples and use larger crutch tips, or you can weight the nipples with lead.—*W. Thomas, Buffalo, N.Y.*



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PS MATERIALS

Masonry Finishes

Why do masonry paints fail? How can you be sure you're using the right combination of materials and techniques? Here are the answers

By Jackson Hand

CONCRETE, concrete blocks, brick, and other masonry surfaces are easier to paint than wood—if you anticipate a few problems by using the proper materials and work methods. Here are some things to watch for:

- Alkali that destroys ordinary paints.
- Efflorescence that ruins adhesion.
- Porosity that soaks up paint, and leaves pigments with no binder.
- Glaze too slick for paint to stick to.
- Texture you may not want and that can cut coverage by more than half.
- Moisture under pressure that will push any paint right off the wall.
- Other contaminants, such as metallic substances.

The alkali problem. Masonry is, by nature, alkaline. With passing time, the degree of alkalinity diminishes. It may disappear entirely, but you can't depend on it. That is why people who know paint always assume that there is an alkaline condition and make their plans accordingly.

The solution: Since alkali plus oil equals soap—and that makes a poor paint substitute—stay away from oil paints. If you must use oil, treat the masonry first with a 10-percent solution of muriatic acid in water. Wait until the surface is dry before painting.

But why take a chance on oil? There are several latex-type water-thinned paints formulated specifically for masonry. In addition, the water-thinned latex house paints perform flawlessly on masonry. So does portland-cement paint—a brushable slurry of special cement and water. So does alkali-proof chlorinated rubber paint, which is tough enough to use in and around swimming pools.

Since alkali diminishes with weathering, it's always best to wait a while before you paint new masonry. There are other reasons, too. New concrete may have oil—or other parting mediums left by the forms—on the surface, which would prevent good adhesion of any paint.

Efflorescence. This is a cousin of alkalinity, forming on the surface as a whitish powder. Do not wash it off. Water will merely bring more of it to the surface. Dry-brush efflorescence with a stiff broom—even with a wire brush, if it is stubborn. As with invisible alkali, the water-thinned house paints or cement paint or chlorinated rubber are safest for use in all cases.

The porosity problem. As everyone knows, if you put a half-dozen bricks in a pail of water, the water disappears. Most masonry will soak up a certain amount of any liquid you put on it. If this liquid is a paint that costs you $5 to $7 a gallon, it runs into money.

Again, water-thinned paints are the answer. With acrylic or polyvinyl-acetate exterior paints, you pre-soak the masonry, and paint after the free water on the surface has penetrated or evaporated. Not only does this control absorption, but it actually improves the performance of the paint by preventing the masonry from pulling out the water before the film has formed properly.

If for any reason you must use an oil-base paint on porous masonry, you can prime the surface with a special sealer-coater. Although some masonry primers are

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special alkyd formulations, the easiest to use are polyvinyl acetate, and you predampen the masonry for them just as you would for an outdoor water-thinned paint used as a top coat.

Although the water-thinned paints are their own primers, many painters use the sealer-coater for the first coat on masonry. It is cheaper than the regular material.

What to do about glaze. Sometimes, when a masonry surface is steel-troweled, it will pick up such a smooth surface from the trowel that it is tile-like—a poor paint base.

This slick surface will weather away in a few months outdoors, but indoors you may have to use a 10-percent solution of muriatic acid to cut the gloss, then rinse. The condition occurs most frequently on floors—and one safeguard against paint failure over glaze is to use chlorinated-rubber floor paint. It has exceptional adhesion.

Cutting texture. Now and then the texture of masonry may be too rough for good looks. Good looking or bad, a rough surface can use up twice as much paint as a surface that is smooth.

If the masonry has been painted before, with a latex or oil paint, there is little you can do about texture. But you can smooth out new surfaces or those that have been coated with cement paint. Mix cement paint a little thick and swab it on in a way that works it well into the texture. (If you use the expanding type of cement paint for this job, you get the bonus of highly increased waterproofness.)

After applying the smoothing coat of thick cement paint, follow with another, thin coat, or with latex paint of the color desired.

Combating moisture. If water under pressure is coming through masonry, no paint will stay on the wall. Some will adhere if the pressure is very slight, but the risk you run is too great. There are cement-based products available that will reduce—or even eliminate—pressure. Over these, you can apply cement paints, through which water will come without destroying adhesion. But do not expect any film-forming paint to do the job.

New on the market are special catalytic

CONTINUED

The POPULAR SCIENCE Guide to Masonry Finishes

	ACRYLIC	POLYVINYL ACETATE	BUTADIENE STYRENE	CHLORINATED RUBBER	CEMENT PAINT	OIL PAINT	CATALYTIC COATINGS
WHERE USED	In or out	In or out	Indoors	In or out	In or out	In or out	In or out
OVER NEW MASONRY	Clean and dampen	Clean and dampen	Clean dust-free	Clean dust-free	Clean and dampen	Clean dust-free; treat for alkali	Clean free of particles
OVER OLD PAINT	Okay if old paint is in good condition. If chalk is great, use sealer-coater. If paint is bad, remove			Okay if old paint is in good shape	Only over old cement paint in good condition	Okay	Never
PRIMER	Self- or sealer-coater	Self- or sealer-coater	Self- or sealer-coater	Self-coater	None	Sealer-coater	None
COATS	2-3	2-3	2	2	2	2	1 or 2
DRYING TIME	1-2 hours to recoat	2-6 hours to recoat	Over-night	Over-night	24 hours to recoat*	24-72 hours	Varies
COLORS	Unlimited	Unlimited	Unlimited	Utility	Pastels	Unlimited	Small range
SURFACE	Velvet to flat	Satin	Satin	Semi-gloss	Dull	Semi-gloss	Gloss or flat

*Requires 48-72 hours of damp curing. Do not let it dry out during this time.

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coatings (urethane and epoxy) that do have sufficient adhesion to resist water under pressure. Originally clear, they are now showing up in colors. You will not find them as easy to use as paint, but if water under pressure is the problem, they may be the only answer. Read labels carefully; everybody's product differs a little from everybody else's.

Surface preparation. When masonry is new, your only concern is alkalinity and, possibly, glaze. When it's old, the surface may be dirty, dusty, flaking, or scaling, and it may require brushing with stiff bristles or a wire brush.

Look for metal, such as form wires or reinforcing steel too close to the surface. Spot-prime such areas with a good metal primer, so that rust-through won't spoil your job.

If masonry has been painted, and if the paint is in good condition, repaint it with no special preparation other than surface dusting. If it is chalking heavily, seal down the chalk with a coat of high-grade alkyd-resin primer or a sealer-coater. Some manufacturers have an additive, stirred into a latex paint, that does the job.

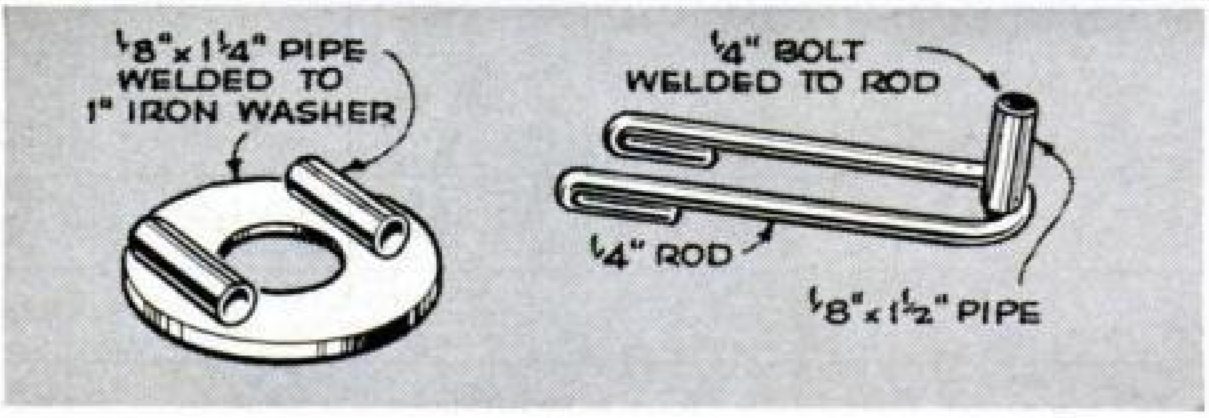
If the paint is flaking or gives other signs of serious failure, the reason is probably alkali. There is no true solution other than sandblasting the old finish off and starting from scratch.

Remember, portland-cement paint can be used over fresh masonry—or over masonry that has been painted with portland-cement paint. It cannot be used over anything else. To get good results with this type of paint, apply it to a dampened surface and keep it damp for 48-72 hours. In a swimming pool, this is simple; fill the pool and you have solved the problem neatly.

Since the emergence of latex house paints as the answer to so many painting problems, more and more paint authorities make no bones about it: The best masonry paint is the latex paint formulated for exterior exposure. Generally, they are their own primers, they go on easily, their color range is excellent, and they have a long life. ■ ■

Short Cuts and Tips | FROM PS READERS

Crank turns drill press for precision tapping



The ideal way to tap threads is in the drill press—but the spindle speed is too great. You can lick this problem and produce perfect work with this drill-press crank. Make it by brazing two short pieces of tube to a washer big enough to fit over the quill. Bend a piece of rod to the shape shown and braze on a handle. Fasten the washer to the quill pulley with epoxy or screws.

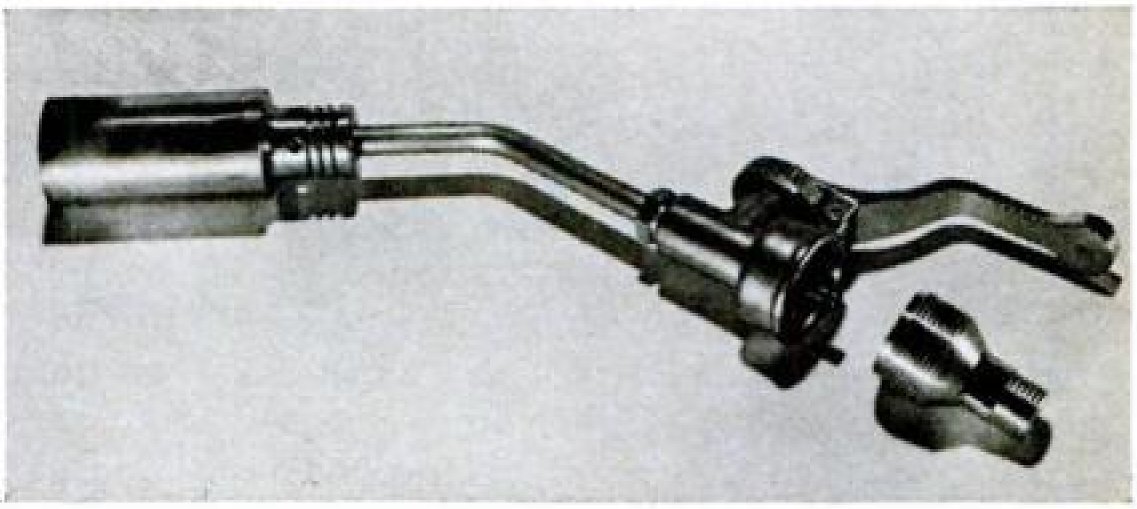
To tap, leave the setup undisturbed after you drill. Chuck in the tap, feed the quill slowly, and turn the spindle by crank. Result: perfect threads.—*W. C. Waggoner, Sacramento, Calif.*

Urheberrechtlich geschütztes Material

SHOP TALK

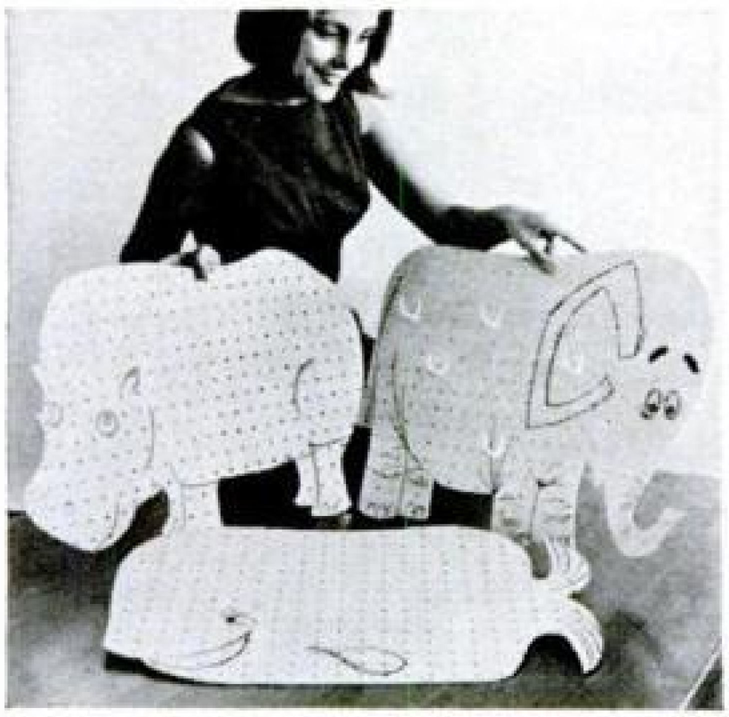
By Robert P. Stevenson

Here's how you can hook up propane accessories to a refillable tank



The threaded brass adapter at the extreme right above makes a propane torch handier and less costly to use. The big end screws into a torch or other head that you normally use with a disposable propane cylinder, the small end into a standard gas hose from a long-lasting refillable tank. You can get the fitting by sending $3 and your name and address to Arnold N. Anderson, 6 Wyoming Dr., Hazlet, N. J.

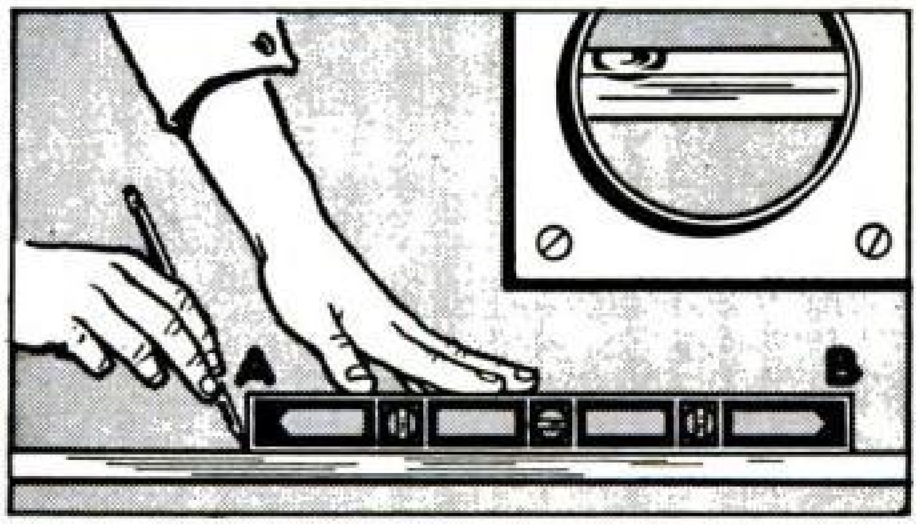
You may be seeing pink elephants—because now you can buy them

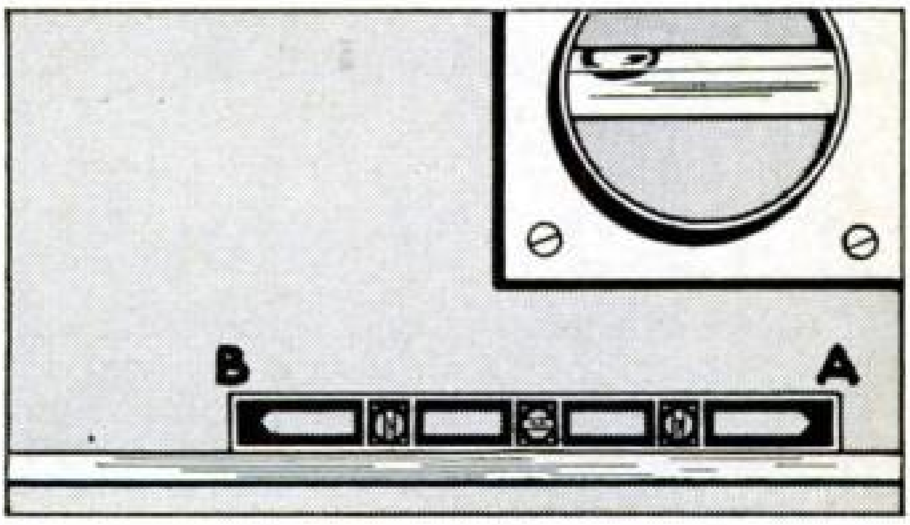


Three storybook characters, Hippy the Hippo, Winnie the Whale, and Elmo the Elephant now come as ready-painted perforated hardboard cutouts. Hippy is yellow, Winnie blue, and Elmo (naturally) pink. Masonite makes them. Good point to remember next time you fix up a child's room.

How to know when a level is on the level

Our friends at Stanley have told us about a good trick for checking a level: Put it on any smooth surface—it doesn't have to be level. Mark point A at one end of the level and note the bubble reading. Then reverse the level in exactly the same spot, putting point B at point A. The level is accurate if the bubble comes to the same position.





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8 Landscape Tricks

Here are the answers to the problem of making an above-ground pool an ornament to your property while providing summer fun

By Carl Sigman

THERE it stands, your plastic pool, as ugly as a watering tank in a cow pasture. Don't you—don't your neighbors—deserve something more pleasant to look at than that?

The need for beautifying the above-ground pool becomes greater and greater as they crop up on more and more lawns.

Small wonder they're so popular. They cost little, they're easy to install, and they take up little space.

You should put a pool where it's handy to your source of water and, if possible, at a distance from trees. Otherwise, you'll soon get sick of skimming out leaves.

An unadorned pool is an eyesore, but its round shape lends itself to attractive landscape design. On these pages are some ideas for turning a scene-spoiler into a handsome addition to your property.

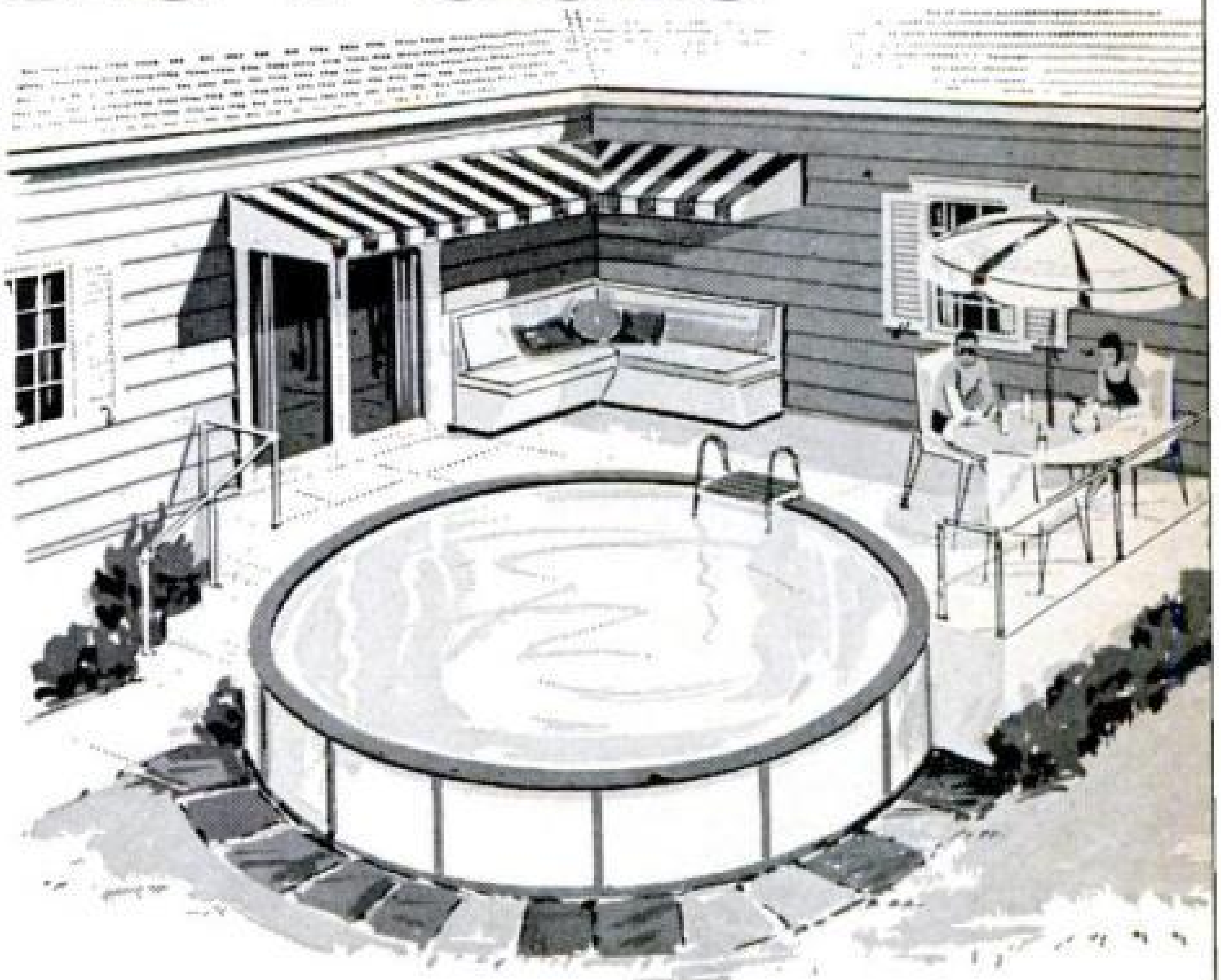
PS HOME IMPROVEMENT

If your lot slopes down...

This is a particularly happy situation. You can have a sunken pool with easy access from your terrace or porch. Of course you'll have the project of excavating a semicircular level area for setting in the pool. Push the earth dug out of the hillside forward to hold the exposed half of the pool. Also, you'll need a retaining wall to hold back the dirt around the excavated area. All loose earth that is moved to make the pool surface level must be well tamped so it will support the weight of the water in the pool. Planting a row of trees or shrubs below the pool will make an attractive screen between you and your neighbors down the hill.

Urheberrechtlich geschütztes Material

for Plastic Pools



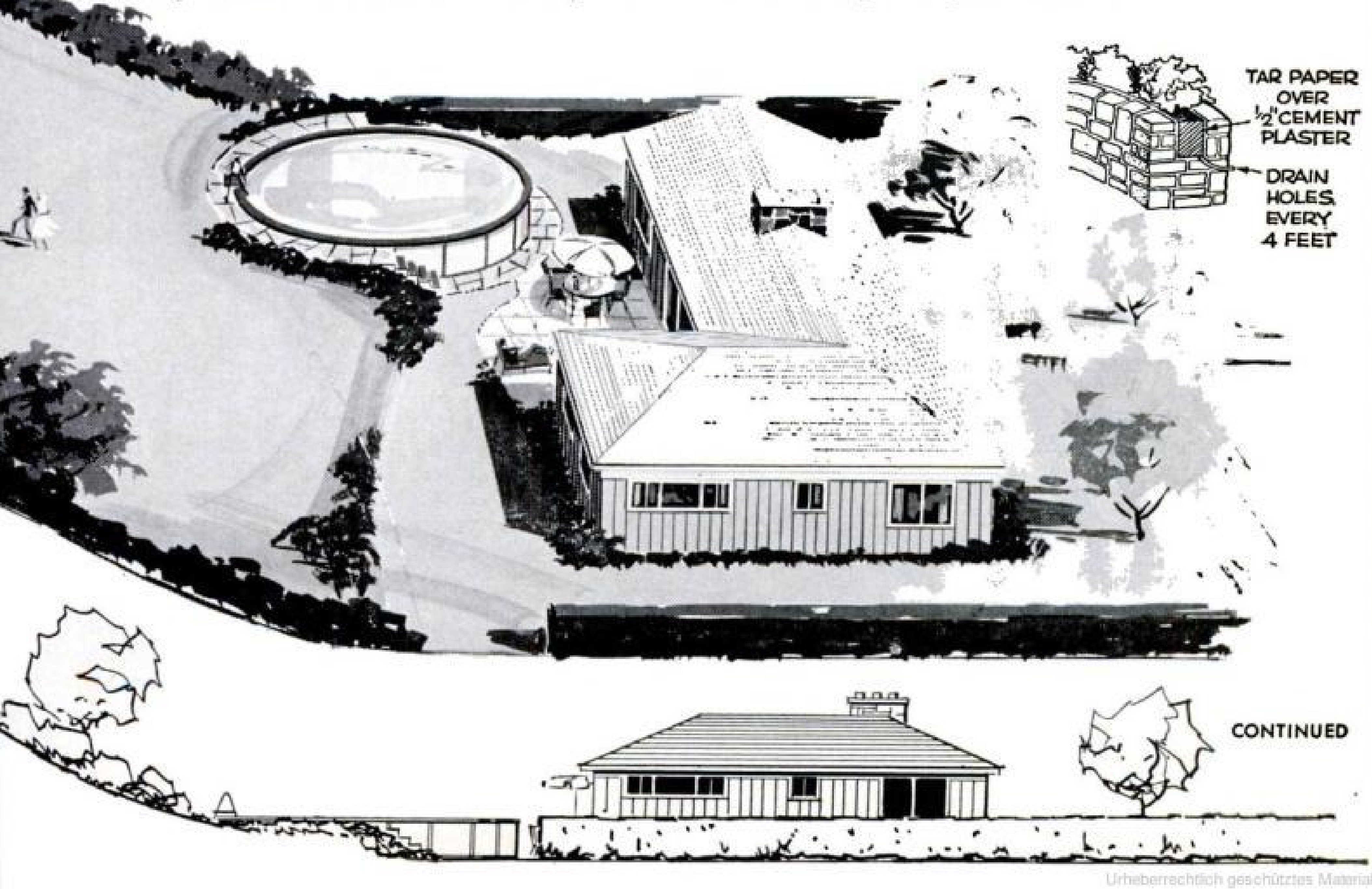
Patio pool

Even if your lot is flat, you can build a terrace up to the pool level —or utilize an existing terrace. Instead of climbing up and over the side of your pool, step into it directly. The corner terrace bench provides a shaded nook for relaxation. If you don't like the idea of a flagstone walk surrounding the pool, you can plant shrubs or perennials along the edge. If you use a water recirculating and purifying system, put it under the raised terrace, with an end door.

If your lot slopes up...

A small excavation project awaits you here. The earth dug up from the upper semicircle of the pool forms the terraces at the sides, as shown below. A retaining wall should be built to hold the hillside. The pool shown here has a shrubbery hedge planted above it for decoration and for privacy from the neighbors who live above you. This wall also serves as a platform right at pool height—a pleasant place to sit and sunbathe or watch the fun in the pool and keep tabs on the kids.

Hedges at sides of the lot give you additional privacy. To dress up the exposed front of the pool, you can plant a cover of flowering shrubs or put up a decorative fence to conceal or camouflage the pool structure.



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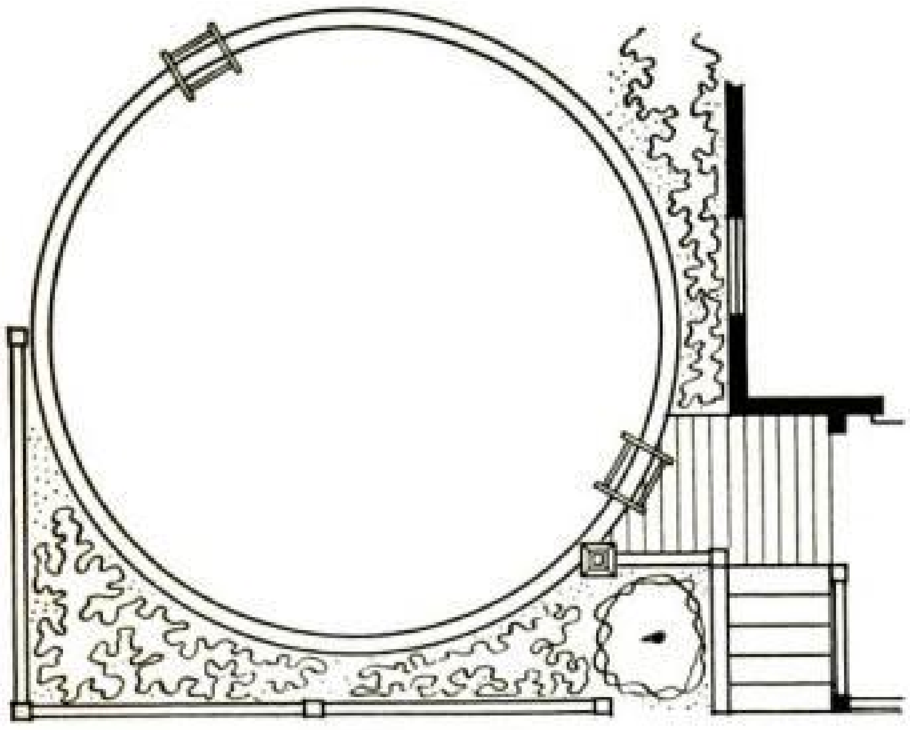
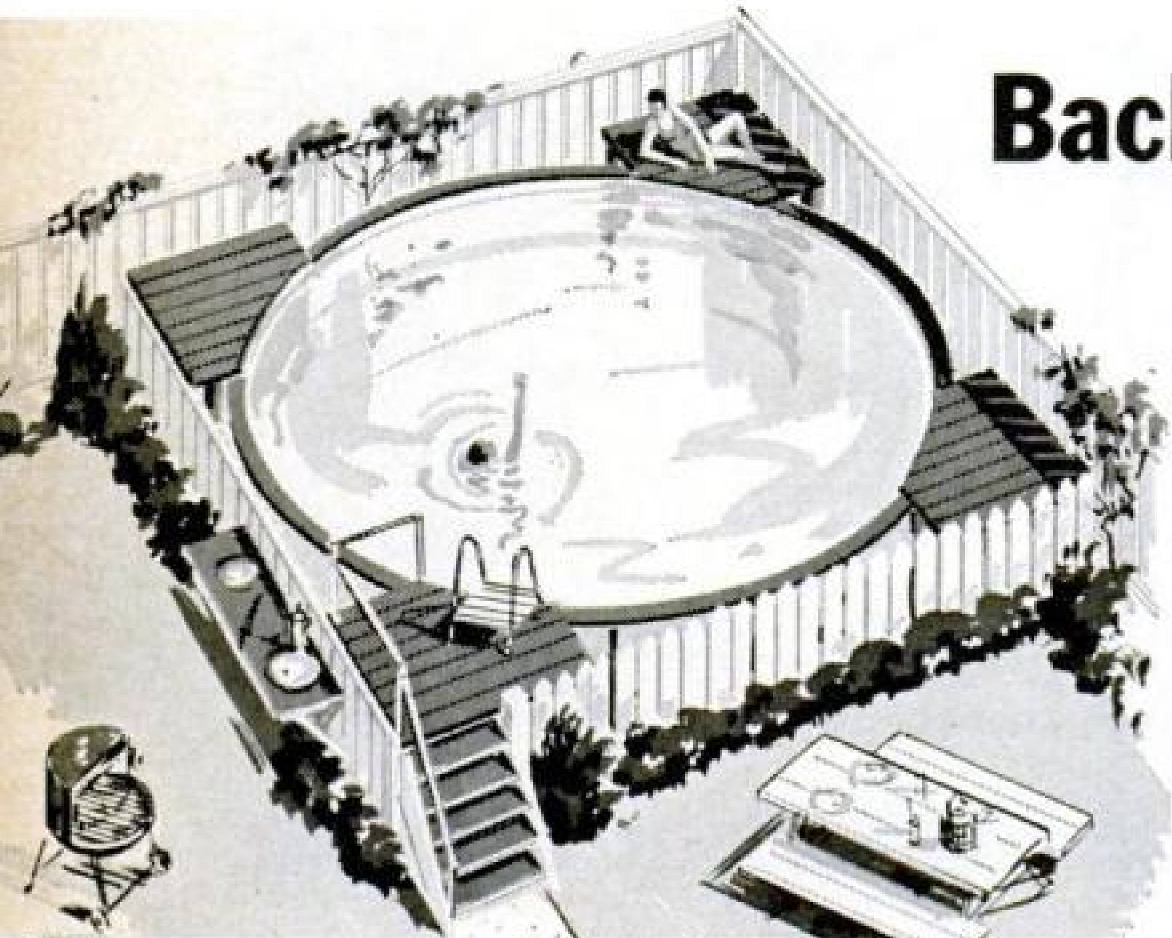


Front-porch pool

A wide side yard and a front porch make it possible for you to place a plastic pool close to the house—and the source of water—and build a platform from the porch to the pool. This will let you enter the pool directly from the porch, or use the porch for between-dips relaxation. Surround the pool on the exposed sides with a trellis about the height of the porch railing. Plant vines over the trellis—such as honeysuckle, which is fast-growing and has thick foliage. A lamp on a post beside the pool will give enough light for a dip at night, and will also serve as a porch light. If you install a water-purifying unit, put it under the new platform between the porch and the pool; be sure to provide easy access from the back side.



Back-corner pool

You want privacy around a pool, both for yourselves and for your neighbors. A corner inside a high fence may be just the place. This one is enclosed by a pool-height picket fence, with platforms in the four corners for sunbathing. Your water-purifying equipment goes under one of these platforms; under another you can build storage for garden equipment.

Best of all, this fence-enclosed pool is decorative, isolated, and compact. You might like to set up a place for cookouts at one corner. Use four-by-four vertical supports for the platform, sunk in concrete. For horizontal supports, two-by-fours are heavy enough. The platforms can be one-by-four or one-by-six boards set ¼" apart. For any platform under which you plan a storage unit, use ¾" A-C outdoor plywood.

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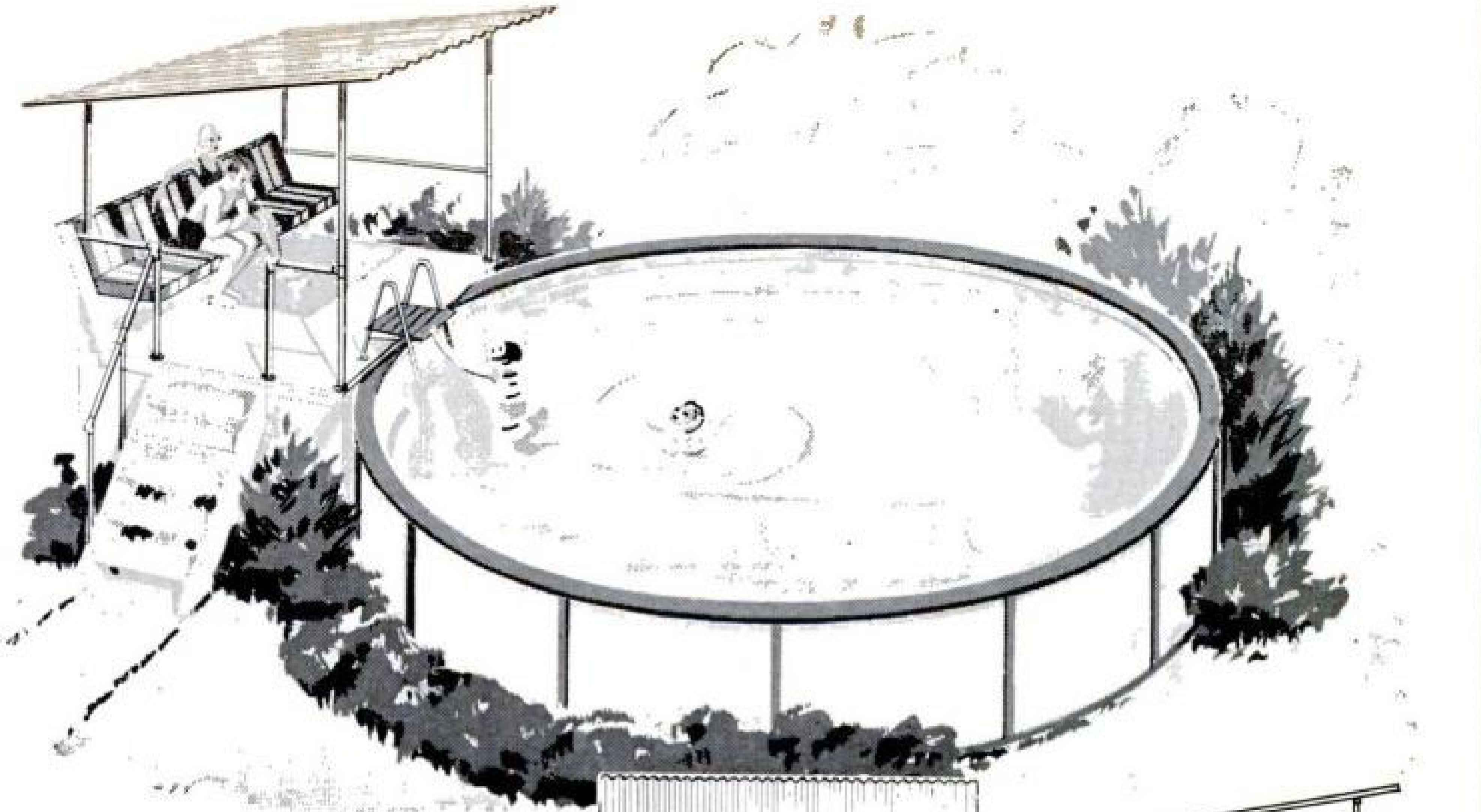
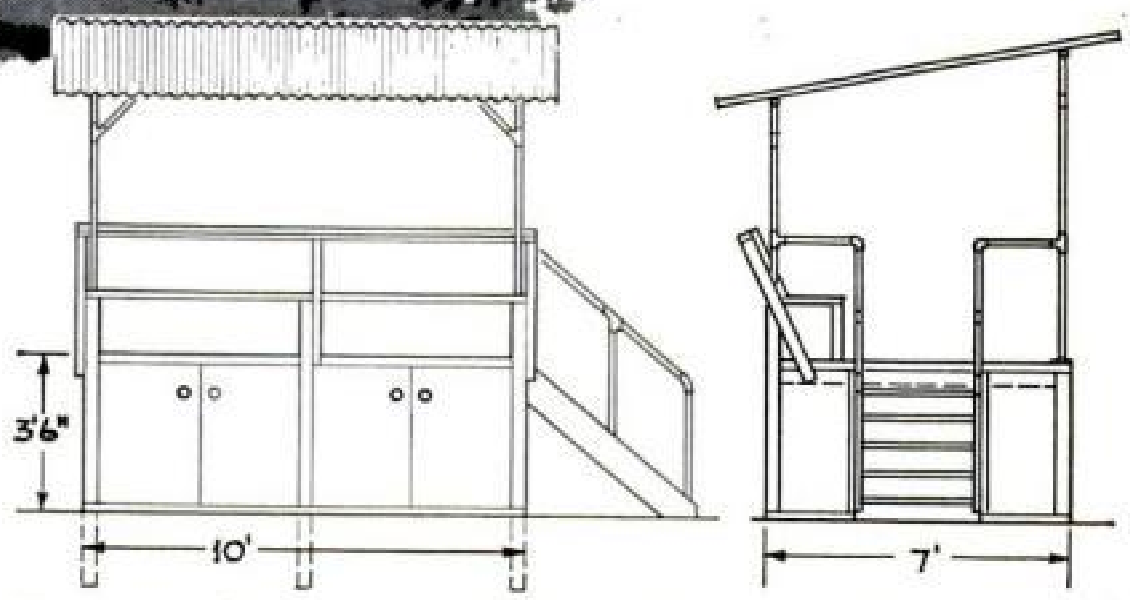


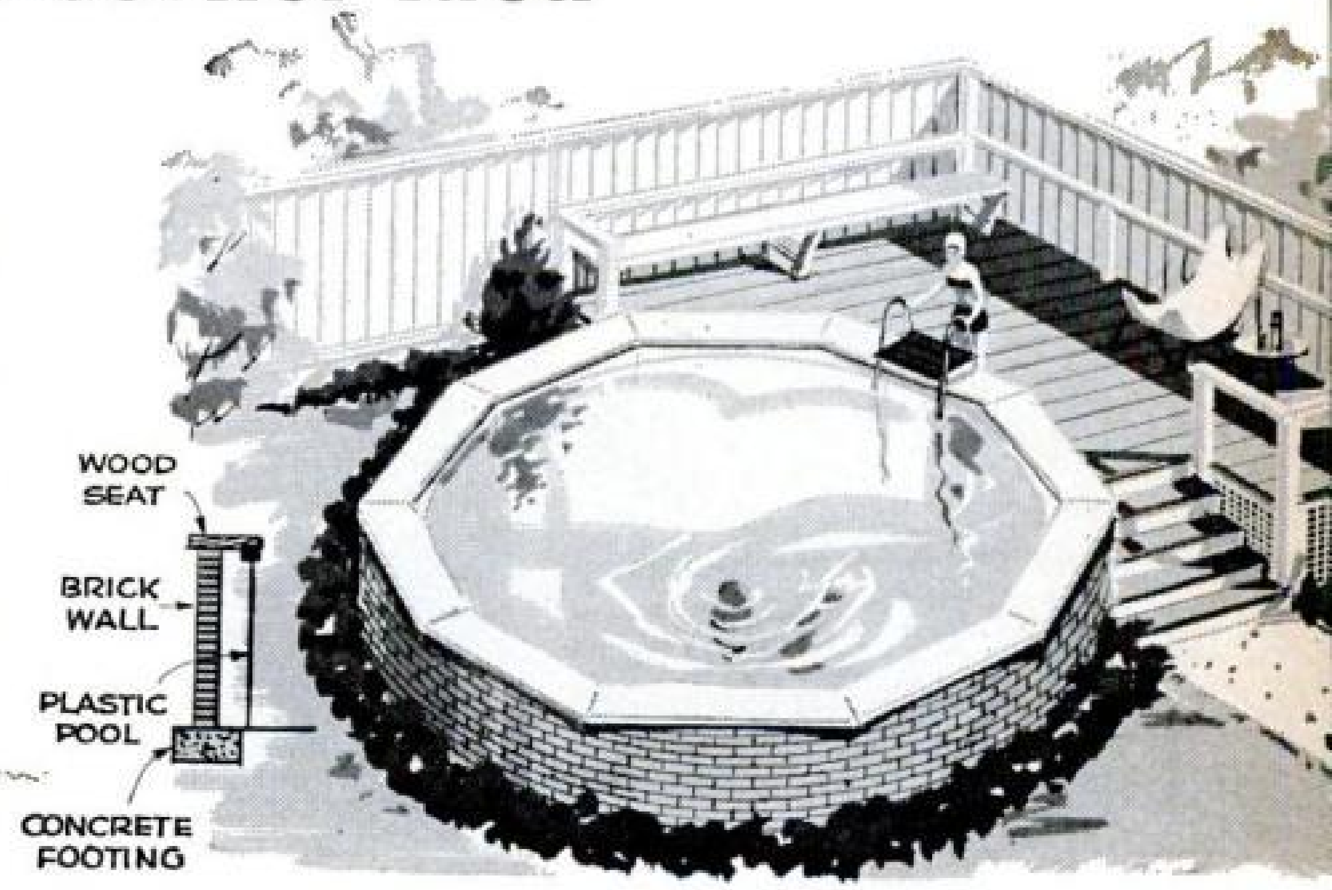
Grandstand pool



Children splashing around in a pool must be watched constantly. This grandstand is ideal. It has a 10'-long bench where several adults can sit and talk in the shade of a sloping translucent corrugated-plastic roof. Use iron or aluminum piping—1¼" or 1½"—for handrails and roof supports, or a two-by-four wood framework, which would look just as good. The cabinets below the grandstand are perfect for water-purifying equipment and garden-tool storage. A 4" concrete slab over a 6" bed of well-tamped gravel makes a good floor. Sink the four-by-four vertical supports in concrete for a solid and long-lasting foundation.

Another back-corner idea

A circular brick wall, laid a few inches out from the pool so you can put a 12"- or 14"-wide seat all around, is another way of enclosing—and decorating—a plastic pool. The brick wall needs an 8"-wide concrete footing poured over a gravel base. The platform in the corner doesn't have to be as high as the pool; you might find greater privacy if you keep it just high enough for storing water-purifying equipment below, and for observation of children. A shade built over the seat adds comfort, and you would find room for a picnic table on the platform. Sink four-by-four posts in concrete for vertical supports; use two-by-fours for the horizontal supports.



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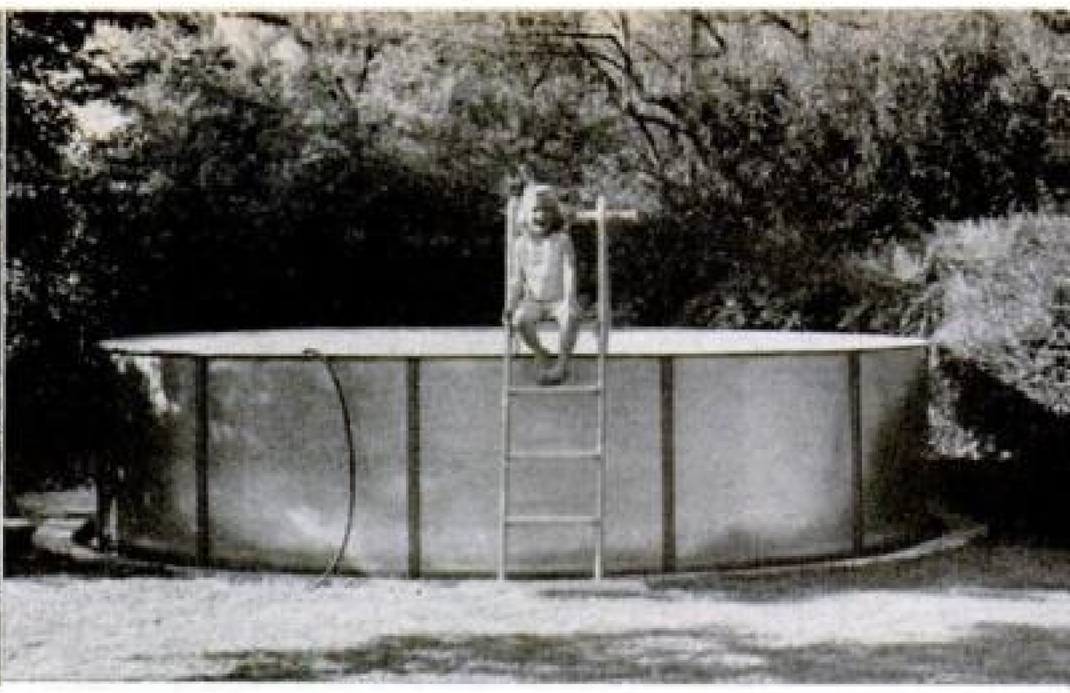
Urheberrechtlich geschütztes Material

When installing a pool, first level the area where it will be. Best practice is to excavate 6" or 8" deep and fill with fine gravel. Concrete-block edge is foundation, mowing strip.



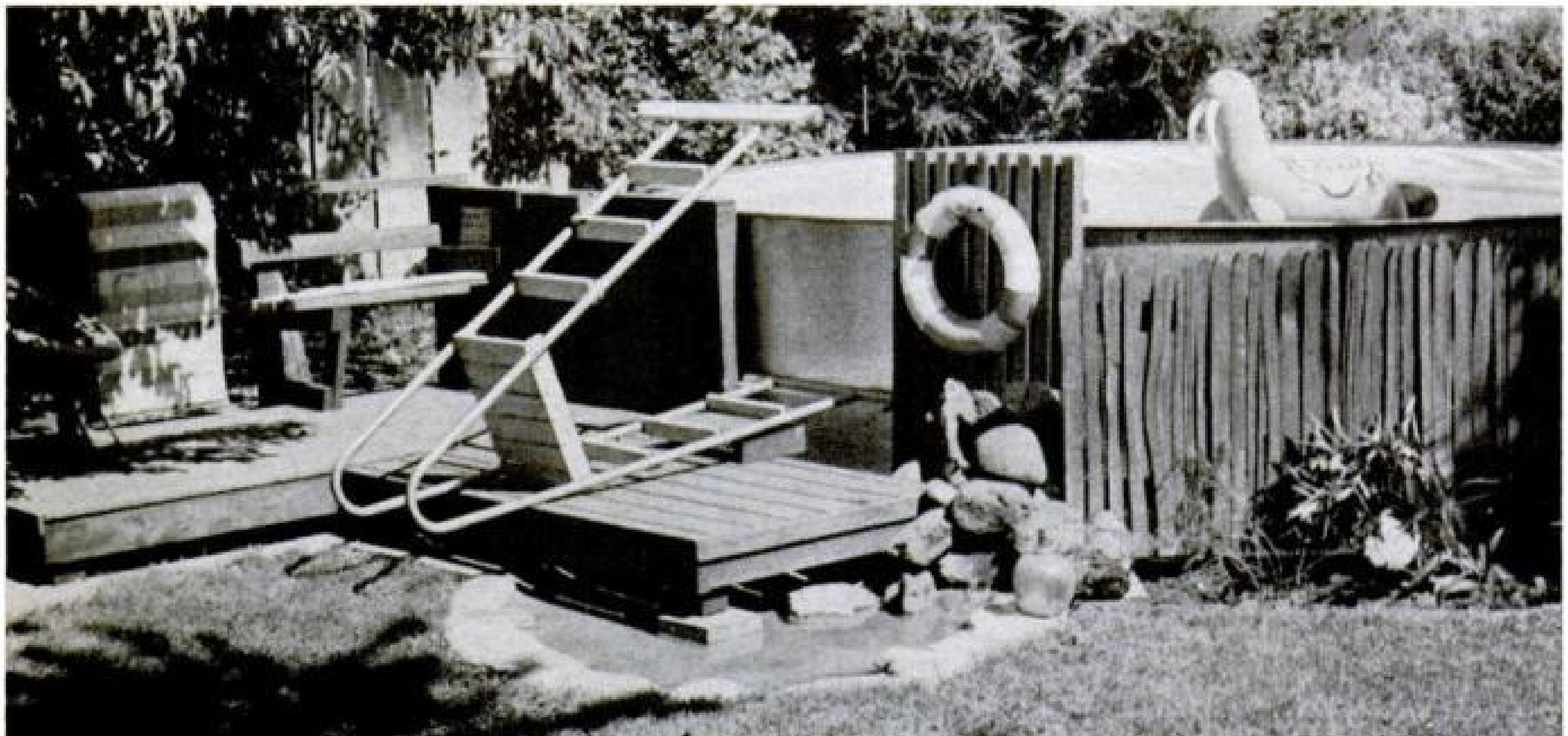
When tank and plastic liner are in place, you can fill the pool and start enjoying it while you figure out how to make it better looking. Bring in electricity early for power tools.

A plastic pool gets a beauty treatment

SEVERAL features of this above-ground pool are adaptable to any plastic-pool situation. A wading pond at the entrance to the ladder tends to rinse away grass clippings and other debris which would otherwise track into the pool.

Concrete blocks have been laid around all perimeters, to act as mowing strips. Filter and pool supplies are stored on the far side of a little fence. An underground cable supplies electricity to the pump motor and pool light. The entire electrical circuit can be disconnected during off seasons when the pool is not being used.

To eliminate the naked look, we surrounded the tank with a sheathing of split-stake fencing and planted flowering shrubs and vines around it.—*Robert Hoppough.*



Tip-over ladder is a safety device. In this position, the children know that the "No Swimming" sign is up. It takes an adult to tip the ladder over the edge, putting it into use.

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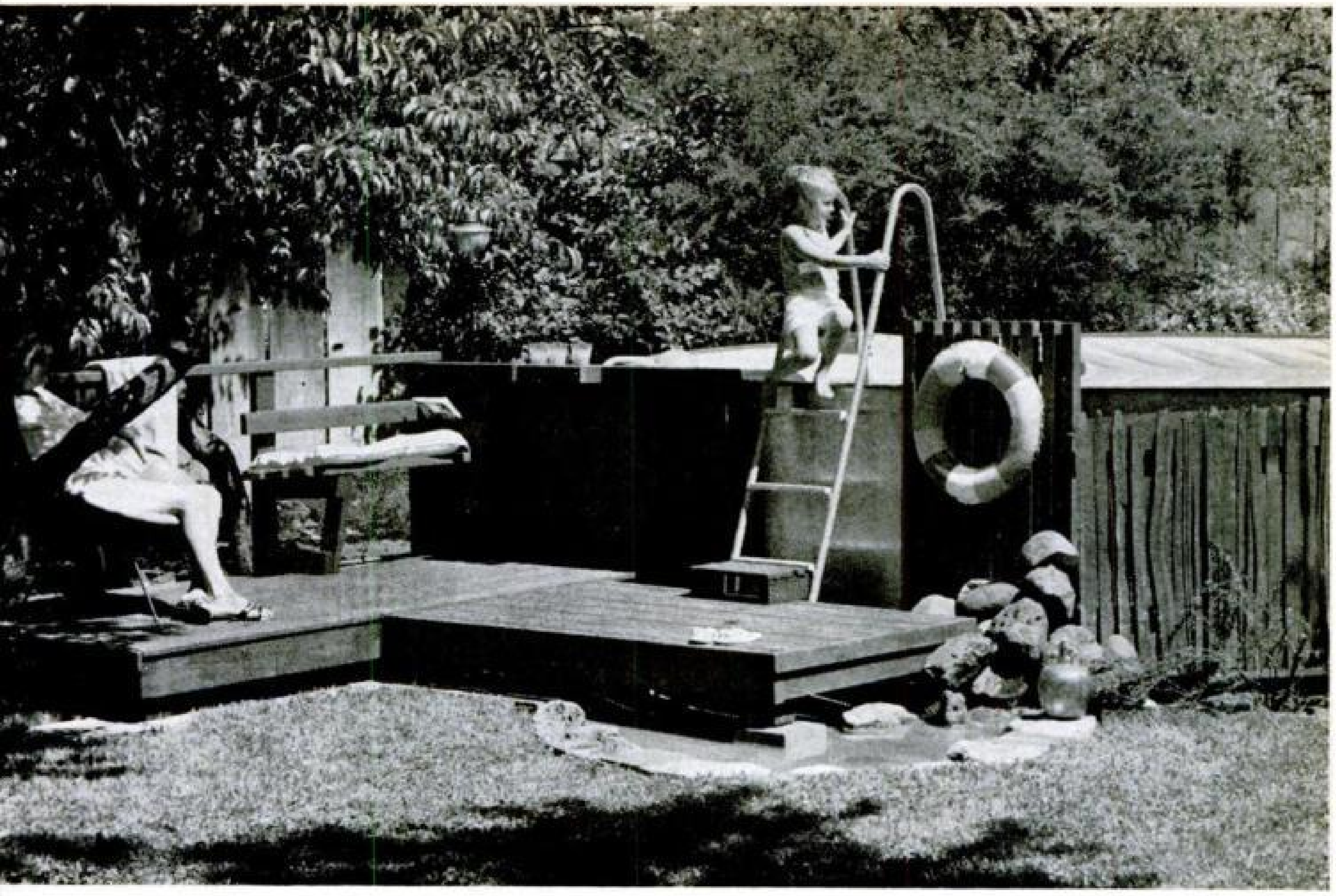
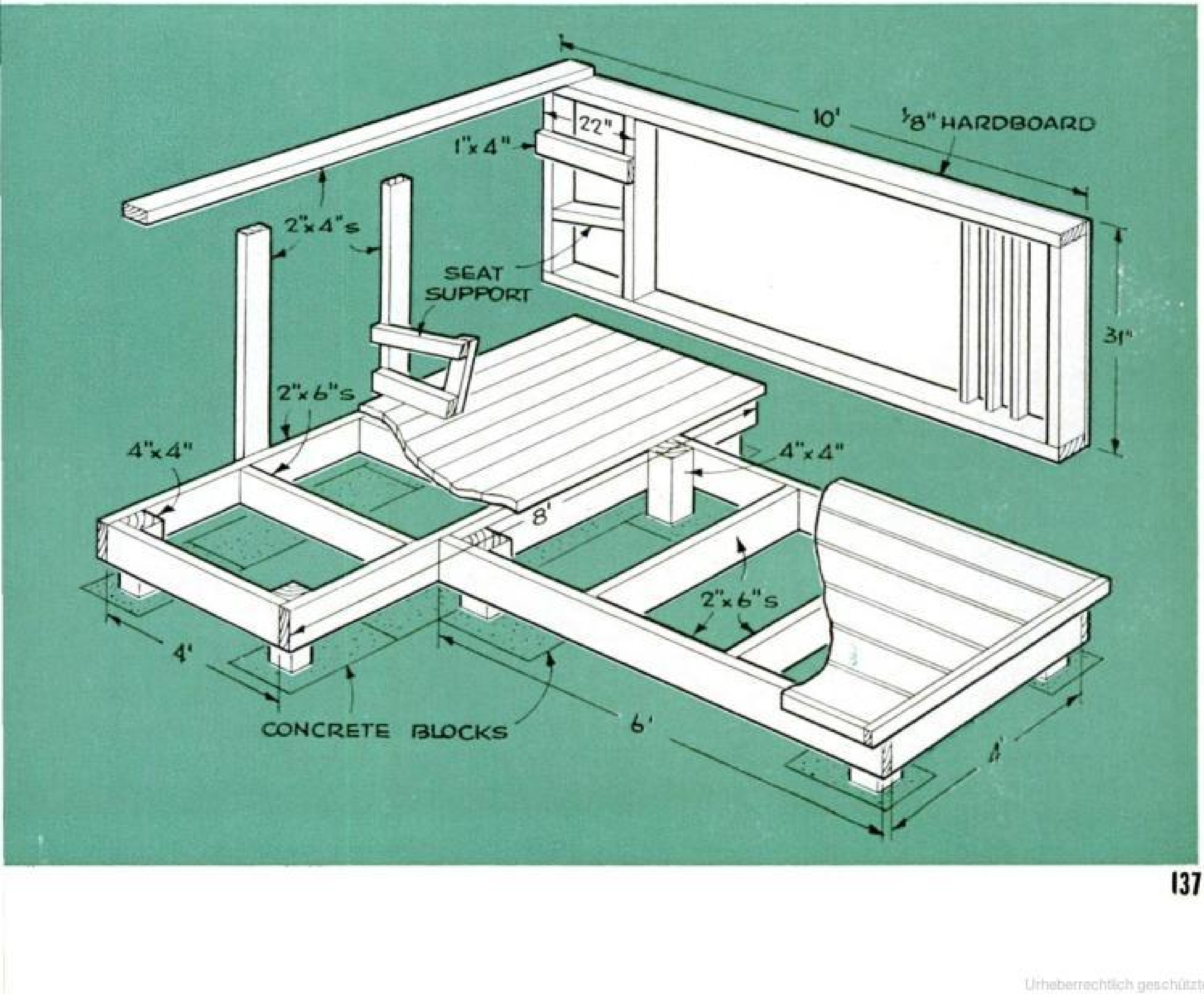


Redwood platform is built in two sections so that it can be rearranged from time to time, for best use. Sketch below shows construction, with stub legs resting on concrete blocks. ■ ■



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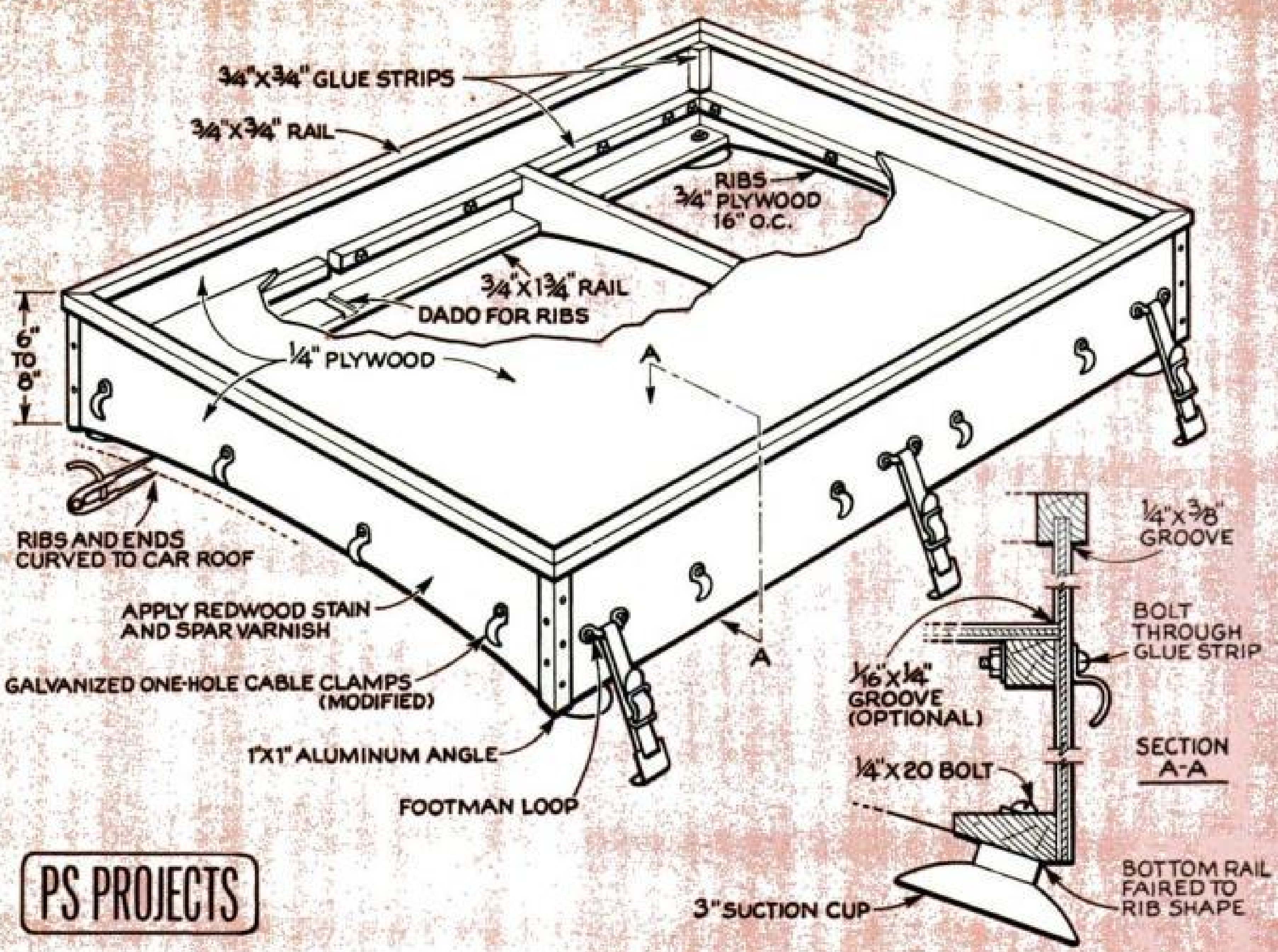

PS PROJECTS

Car-Top Carrier for Vacation Luggage

By Ernest E. Hickman

THIS cargo box is custom-tailored to your car roof, but slick appearance is only a by-product of the design. The close fit reduces both the roar and lifting effect of the wind. Even if the six suction cups couldn't hold it on (and they can), any four of the six tie-down straps would.

Although it is strong enough to hold anything the car roof can safely support, the box is extremely light. It is made of plywood—most of it ¼"—carefully stiffened in a modified stressed-skin design. Exact dimensions aren't given; within limits, they must be determined by the car roof. One limiting factor is the necessity for a secure grip on the roof gutters; if the box is built wider than the roof or the gutter, hooks won't hold. If it is too narrow, the load-supporting suction cups will be too far inboard to rest on the supporting structure of the roof at the edge.

You may find construction easiest if you cut the sides and ends to size, curve the ends to fit the top of the car, and then put them together, using glue strips and aluminum angle at the corners. Next install the strips that support the bottom, using glue and the bolts that hold on the lashing hooks. Then cut and curve the ribs and rails to fit and put them in place. Finally, install the bottom and glue the railing around the top. Use screws and marine or weatherproof glue.

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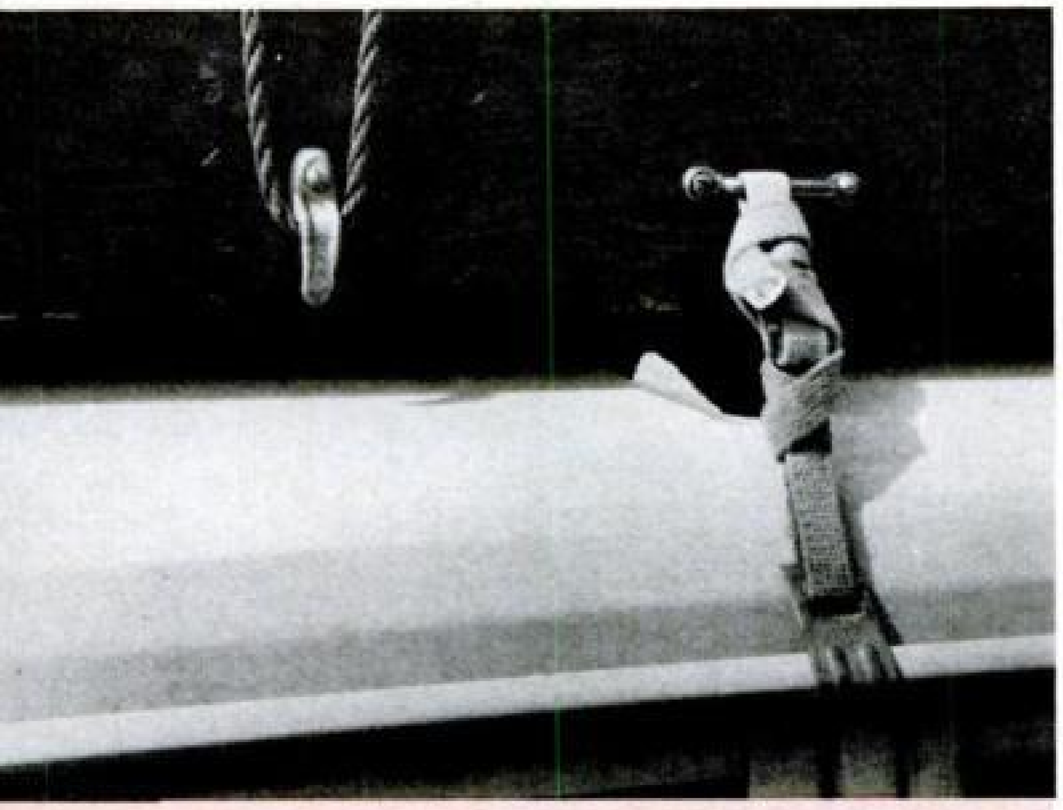
Finish the carrier with exterior stain and spar varnish—or make a perfect match for your car by using automobile enamel. Give an auto-supply dealer your make, year, and color name.



Tie-down shown here is modified electrical conduit clamp bolted through the floor support cleats. Straps go through footman loops. Gutter hooks are standard at auto-supply outlets.

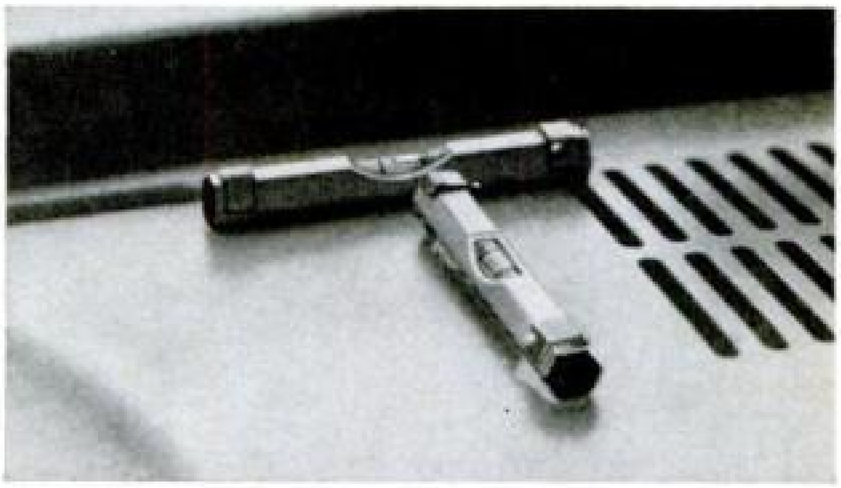
Chrome-plated hardware for the box will be found in a boat shop. Hooks commonly used to hold boat-cover tie-downs make good lashing hooks; loops used to anchor battery-case straps will hold the gutter hooks. Or you can modify electrical conduit clamps, and use harness maker's footman loops. Get gutter hooks and web straps at auto-supply stores.

Install the box by sliding it across the car roof on cloth pads beneath the rubber cups. Wax paper or thin polyethylene film will keep the cups from sticking. Once it is in place, remember that while the box might stand the load, it is a wise policy never to carry more than a maximum of 250 pounds on a car roof.

3 Conveniences for Camping Trailers

1 We carry a supply of drinking water in a 2½-gallon plastic jerry can in a cupboard over the sink. Spacers on the floor of the cupboard keep the can from sliding about. A notched piece of plywood fastened to the inside of the cupboard door fits around the neck of the can when the door is closed. You draw water through a siphon arrangement.

2 Drain water from the sink is caught in a plastic jerry can if we stop where there's no sewer connection.



3 As a guide in parking our camper on an even keel, using epoxy cement we mounted two bubble levels at right angles to each other on top of the dash.—*Willard Allphin.*

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An Important New Series Begins!

Improving Your Home

THIS MONTH: How to install a new outlet

By George Daniels

NEED a new outlet to make things handier around the house? Adding one is a simple job. All it amounts to is *shutting off the current* at the main switch and running a length of cable from an existing outlet or junction box to the new outlet. The wires and the terminals you connect them to are color-keyed to each other, and the wiring hardware fits together like parts in a kit.

The same wiring principles apply whether you start your new line from a box in the

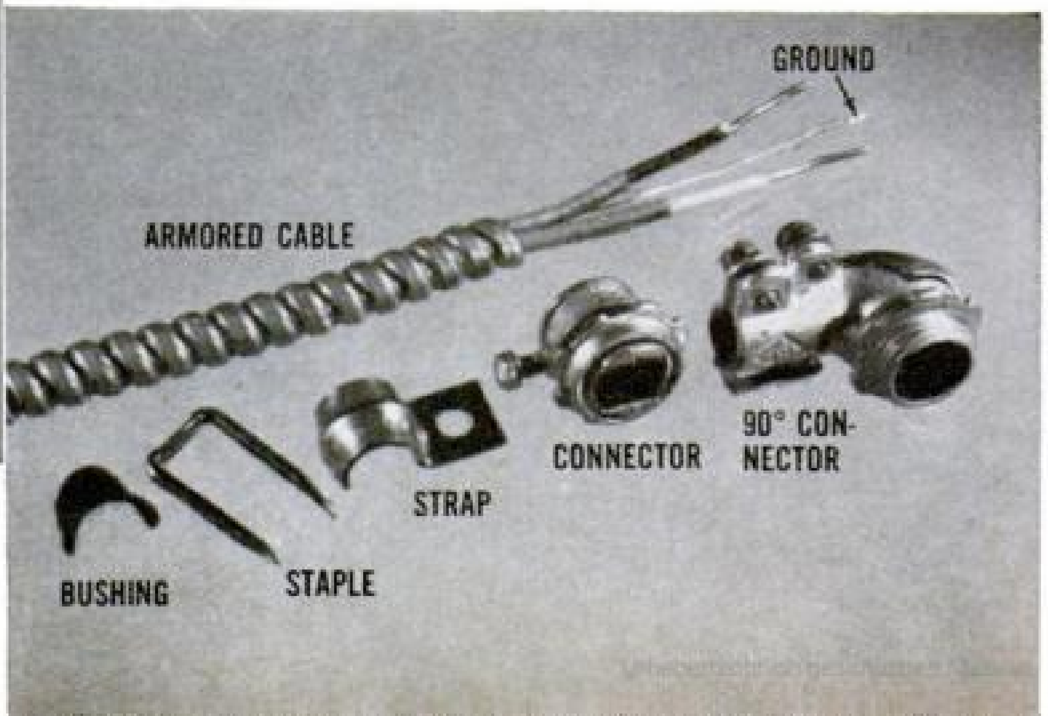
CONTINUED

Your first decision: What wire size?

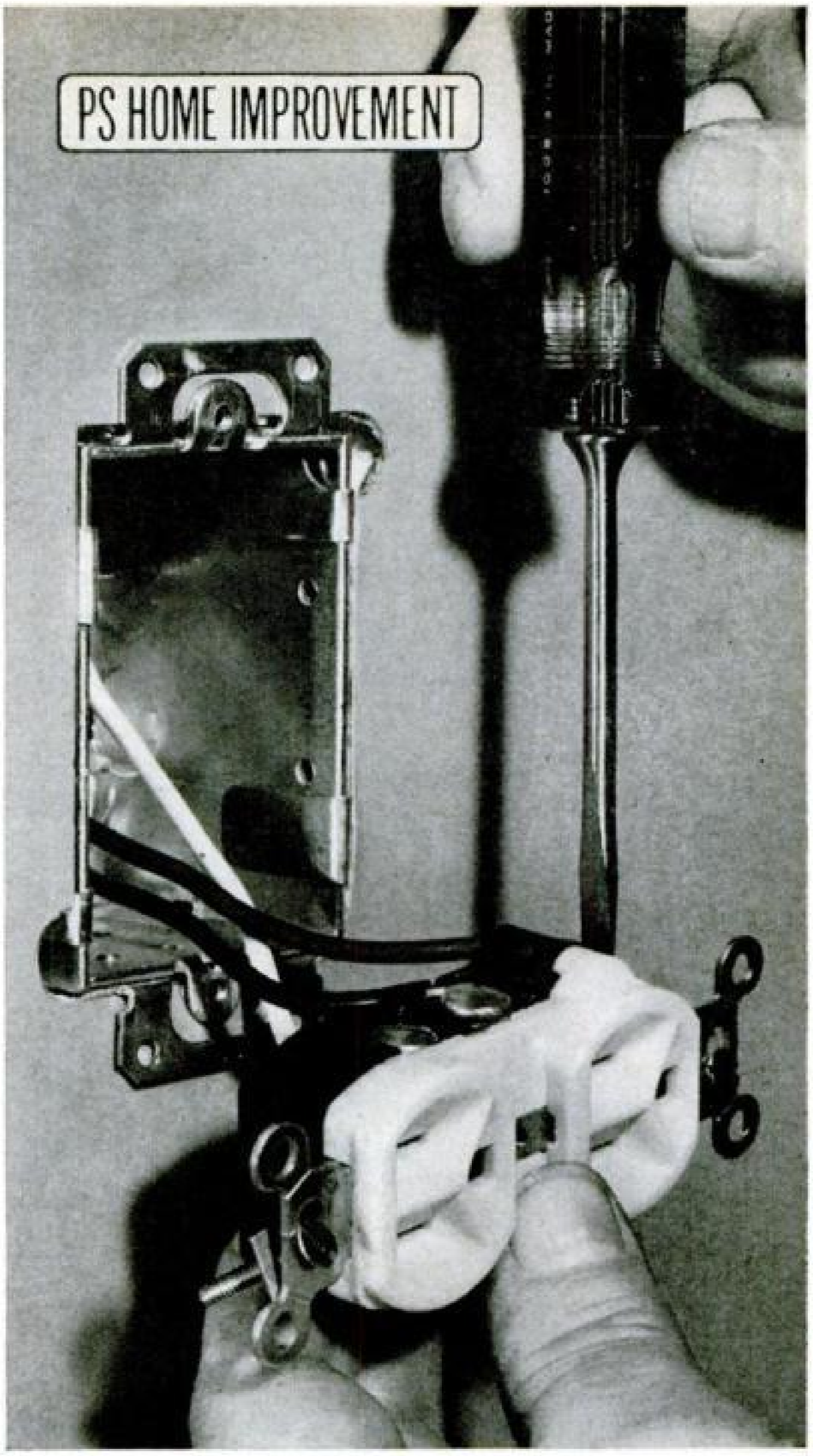
What's the new outlet for? The use to which you'll put the outlet should guide you in your choice between the two wire sizes most commonly used in house wiring. If you'll use the outlet just to plug in lamps and small-load appliances, and you're extending a circuit that has No. 14 wire fused at 15 amps, you can continue this wire size. But if you're extending a 20-amp circuit, you must use cable with the larger No. 12 wire. In any event, never use wire smaller than that in the existing cable leading to the box from which you start your new wiring. Use a known sample to check wire size.

Your second decision:

Armored cable like BX offers good wire protection, must have fiber bushings in ends to protect wire insulation. It may be stapled or clamped. As minimum bends must not be less than seven times cable's diameter, use right-angle connector for sharp bend at box.



Wiring



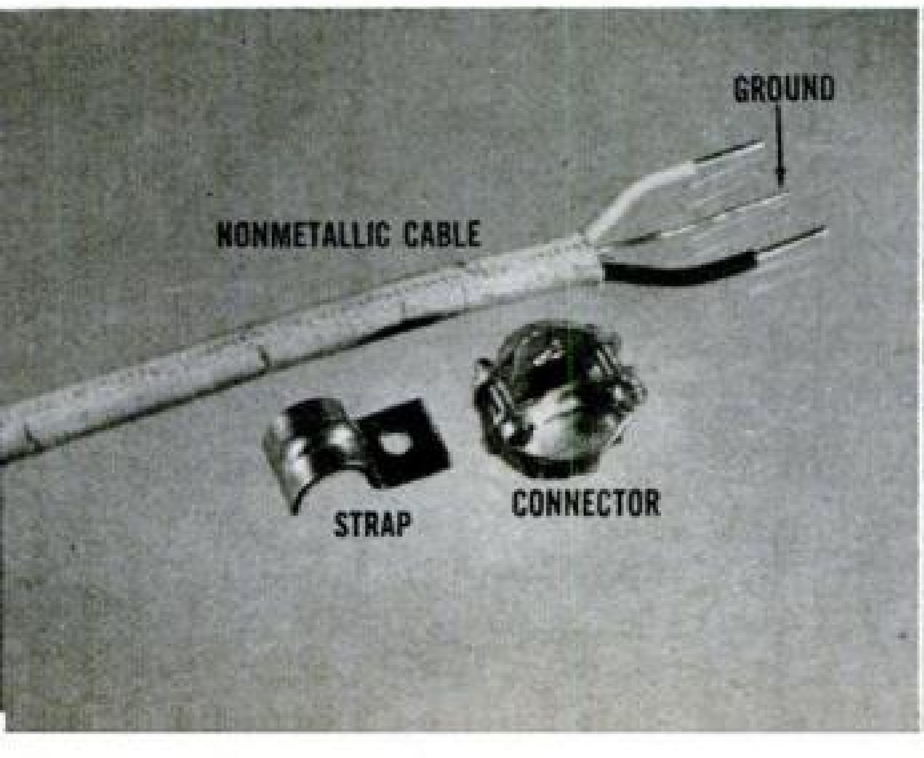
Can You Do Your Own Wiring?

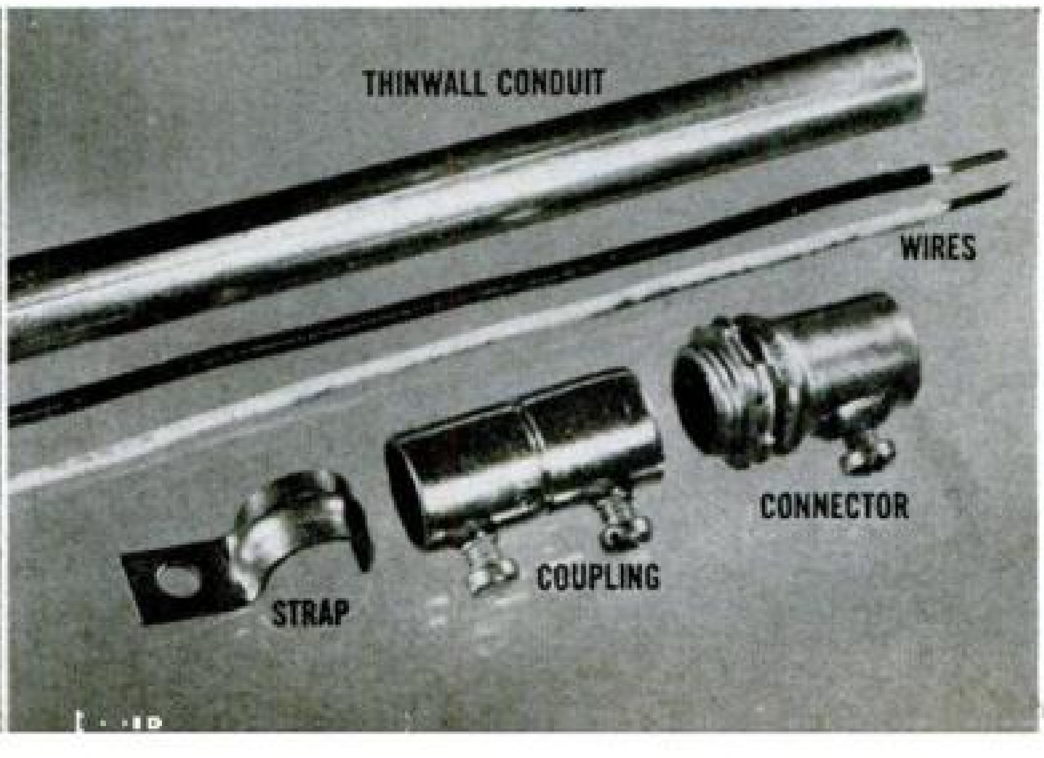
The National Electrical Code *does not* say a home owner may not work on the wiring of *his own* home. The same is true of most local codes. Some communities even provide a pamphlet to help him avoid wiring errors. If your locality has its own code, it takes precedence over the National Code, though it's usually based on it. You'll probably need a permit for your wiring. Fees for this vary widely but in typical areas checked are in the $3 to $5 range, and include the cost of inspection. Get a copy of the Code and ask the inspector any question it doesn't answer for you. Helping you avoid trouble is part of his job.

Which one of three types of cable?

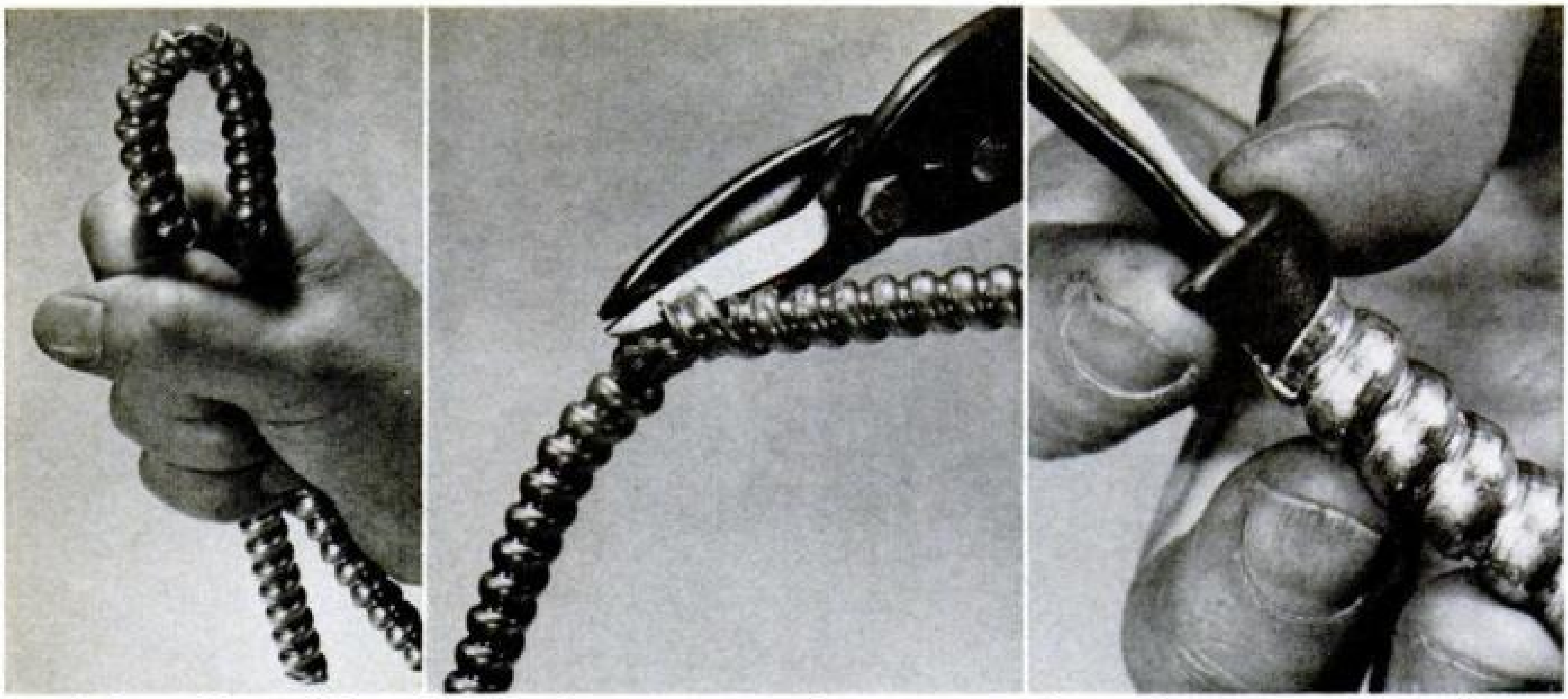
Nonmetallic sheathed cable like Romex is lowest-priced type, very easy to handle, but more easily damaged than BX. Use straps instead of staples for mounting it. As minimum bend radius is only five times cable diameter, an angle connector is seldom needed.

Conduit is required in a few areas. This is like pipe. Wires are pulled through after conduit is installed. In the thinwall form shown below, it's strap-mounted and connected to boxes with special conduit connectors. Ten-foot lengths of the conduit are joined by couplings.





An easy way to cut armored cable, prepare the connection



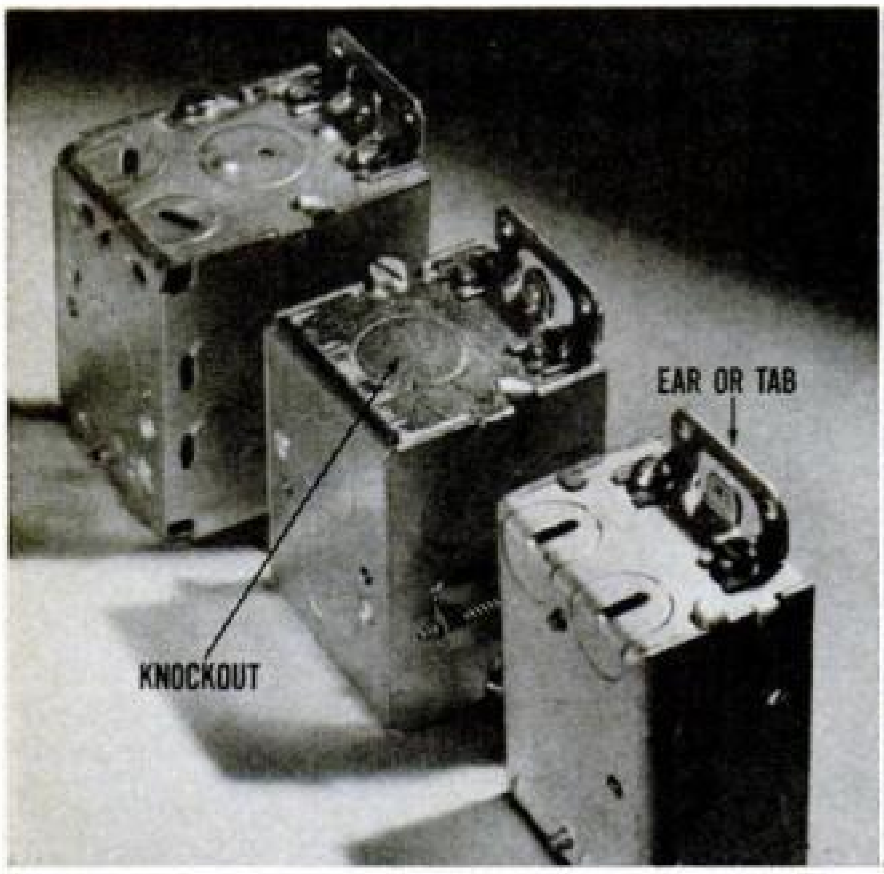
Bend the cable tightly to buckle the armor, as above at left. Then twist it against the spiral, using both hands, so buckled armor lifts outward. This lets you slip shear blade under it for cutting without danger to wire insulation. Use pliers to reshape the cut armor. Then slip a fiber bushing inside, around the wires, as at right. Hacksaw may be used instead of shear.

same room, the opposite face of an inside wall, the basement, or the floor above.

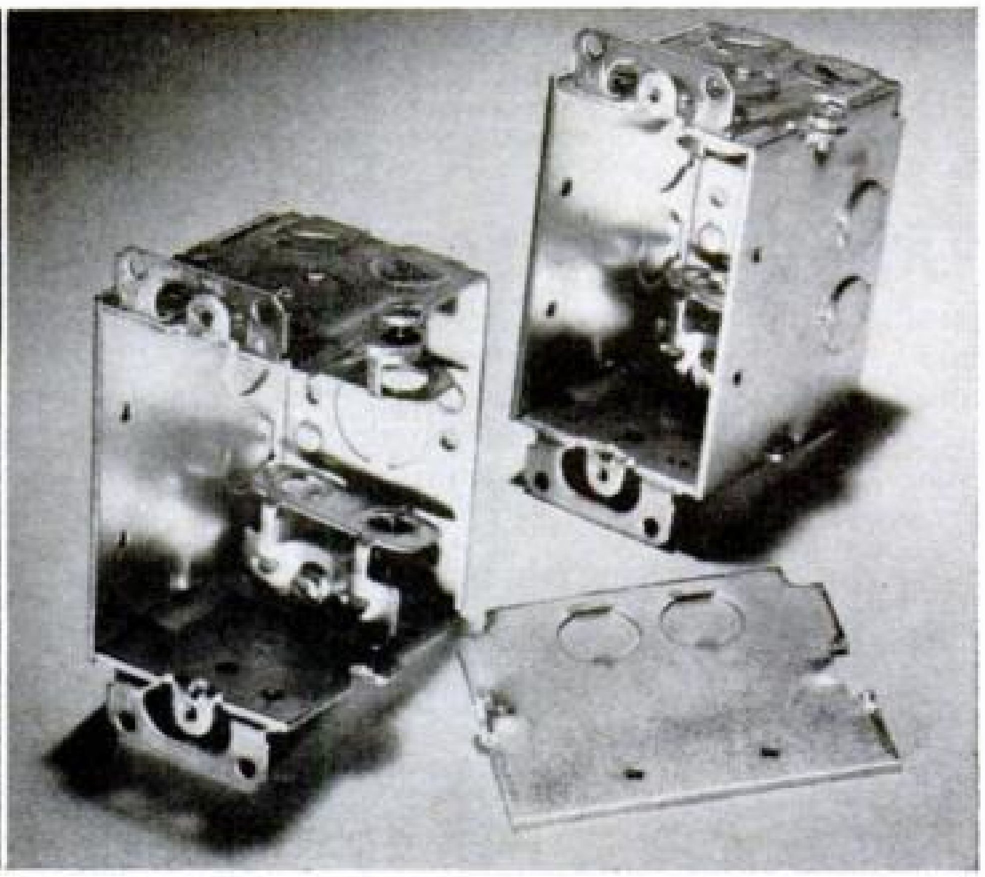
The wire size you use depends on the load-carrying capacity of the circuit to which you add your outlet. You select the circuit according to what you want the outlet to do. If it's merely to supply a lamp or two or an appliance in the small-load ranks (a radio, for instance), a circuit with a 15-amp fuse is good enough. Most codes allow No. 14 wire for this. It's the smallest house-wiring size okayed by the National Electrical Code, and it has certain advantages. Because it's easy to form around terminal screws and easy to flex into boxes, it makes the job easier. And it costs less.

If your new outlet is to handle bigger things, say an electric heater or a husky vacuum cleaner, you'll need the extra margin of a 20-amp circuit. This calls for a minimum of No. 12 wire, a little bigger and a little stiffer to handle.

Your third decision: Which outlet box?



Outlet boxes vary in depth from as little as 1¼" to 2½" in common types, even deeper in special ones. Use the deepest standard size inner wall space permits, to make the job easy.



Removable sides of flush (in-the-wall) boxes permit boxes to be "ganged." Remove one side from each box, join open sides together with screw that held side. Note built-in clamps.

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In either circuit rating, never use smaller wire for your new run than the wire already in your starting box. (Connecting a larger wire to a smaller would be okay.) Be sure to connect into a circuit that isn't already loaded near its limit.

The type of cable is up to you unless you face local code restrictions or special problems.

Armored cable like BX is the toughest, so it's a good bet wherever wiring needs mechanical protection, as along exposed runs. You cut it as shown in the photos at left. To free the wires for connections inside the box simply cut the armor about 8" from the end and slide it off. Prices range from around 8 cents a foot in No. 14 wire size to about 11 cents for No. 12 wire.

Nonmetallic sheathed cable is covered with fabric instead of metal and is easier to use and to cut. To free the wires you lay the oval-sectioned cable on a flat surface and run the point or a knife lengthwise between the insulated wires. As the bare grounding wire runs down the center inside the cable you won't cut the insulation on the others if the blade goes deep.

After the hide is slit, peel it back and snip it off. Keep in mind that this type of cable isn't as tough as BX. It's the lowest priced of the common types—around five cents a foot in No. 14, six cents in No. 12.

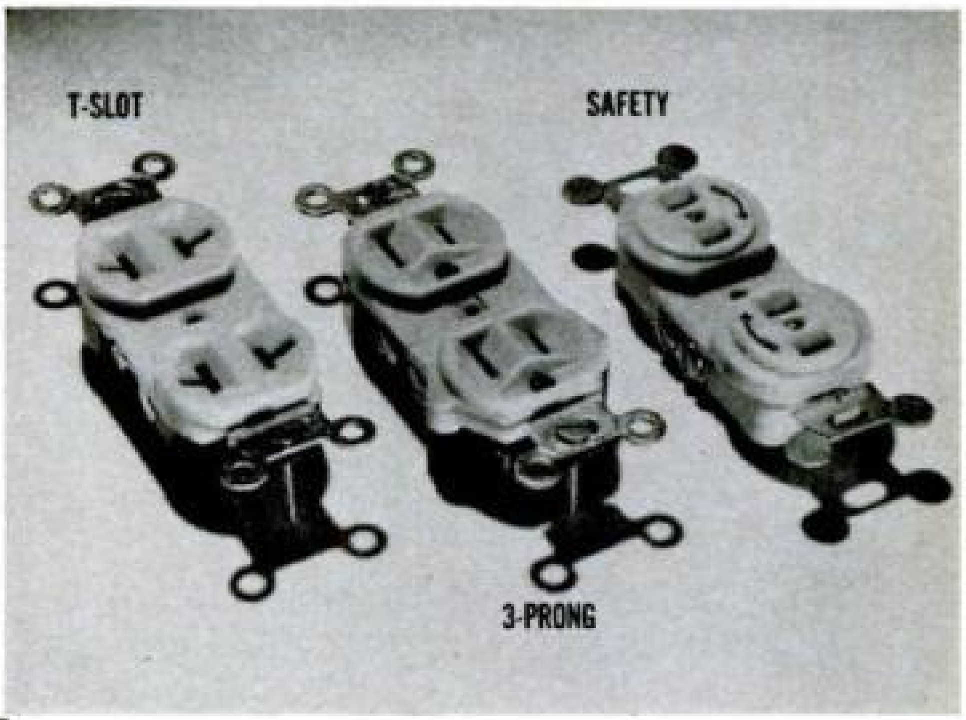
Moisture-resistant cable is made in several forms, but the king of the group is designated as type UF, which stands for underground feeder. If you have to lead your wiring through a damp crawl space this is the cable to use. You cut it and free the wires in the same manner as ordinary nonmetallic sheathed cable—with metal snips, wire cutters, or side-cutting pliers. Prices range from around 7½ cents a foot in No. 14 to 11½ cents in No. 12.

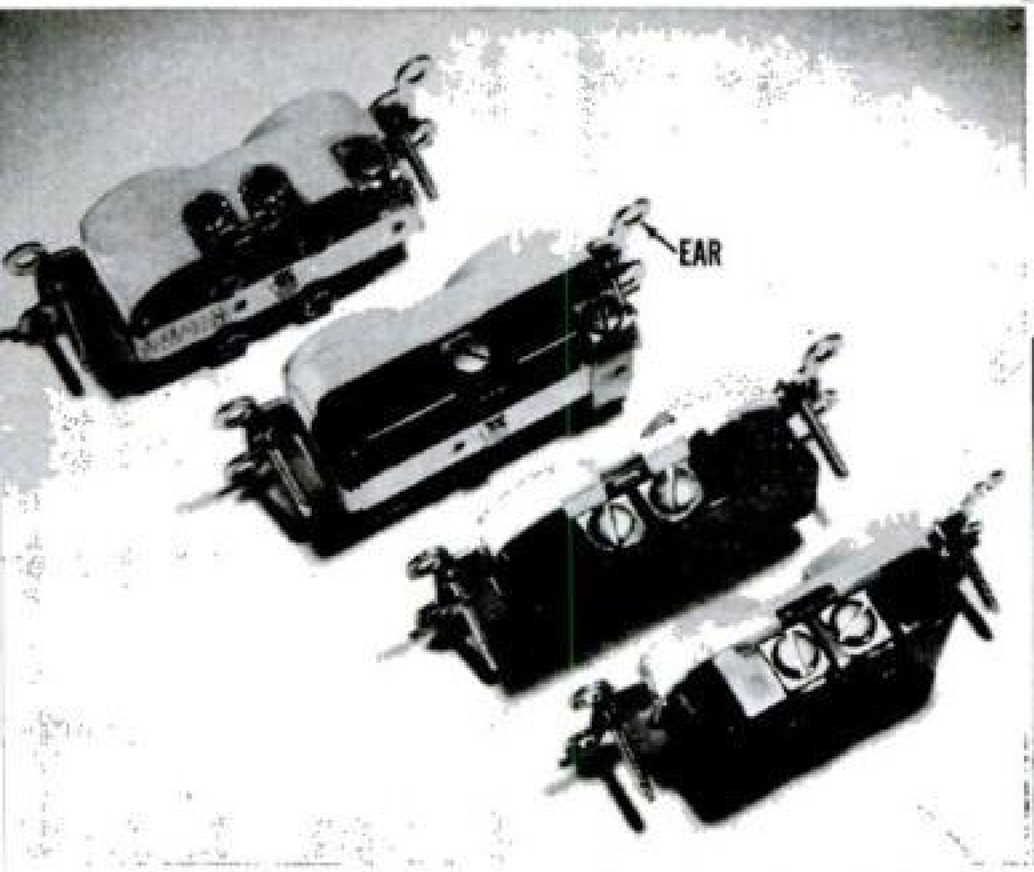
Whatever type of cable you use, be sure

CONTINUED

Your fourth decision: Which receptacle?

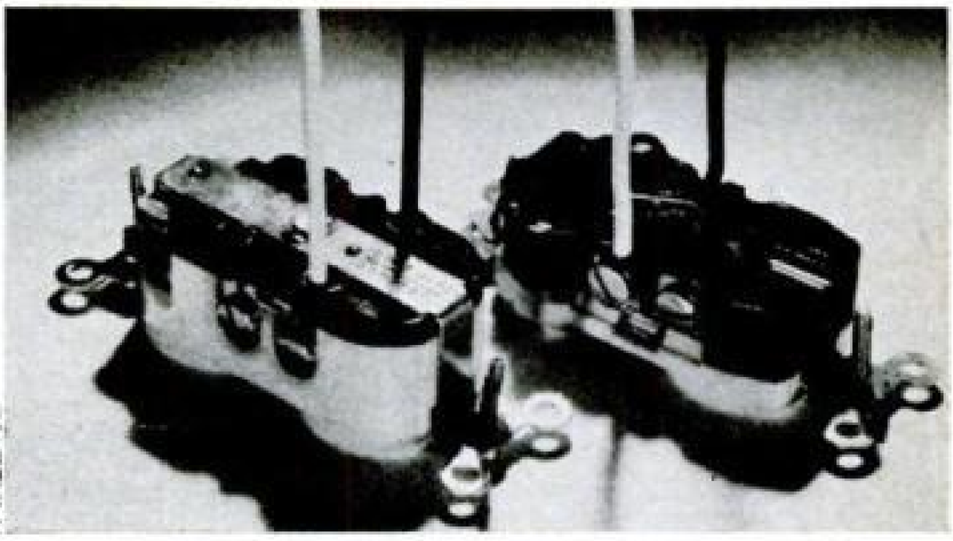
Grounding receptacles (for either two- or three-prong plugs) are required on all new work, including an outlet. Other types are okay for replacements. Mounting-hole spacing is standardized, so all types fit conventional boxes. Childproof safety receptacles (two-prong only) are made in several types. Slots of the one shown stay spring-closed until cap is rotated (arrows). T-slot receptacles will accept any of three types of plugs—polarized, two-prong, or T-blade.





Terminal screws are usually paired, with break-out tab between. Remove tab, and each outlet can be on separate circuit. Single-screw type has grooves for a wire on each side of screw.

Which way should you loop terminal wires for safest connection under the screwheads? A difference of opinion exists, but most pros favor looping wire clockwise, as at left.



Back-wired receptacles can be connected by inserting wires in holes in back of unit, then tightening terminal screw. When handier, wires may be connected under screwheads, as usual.

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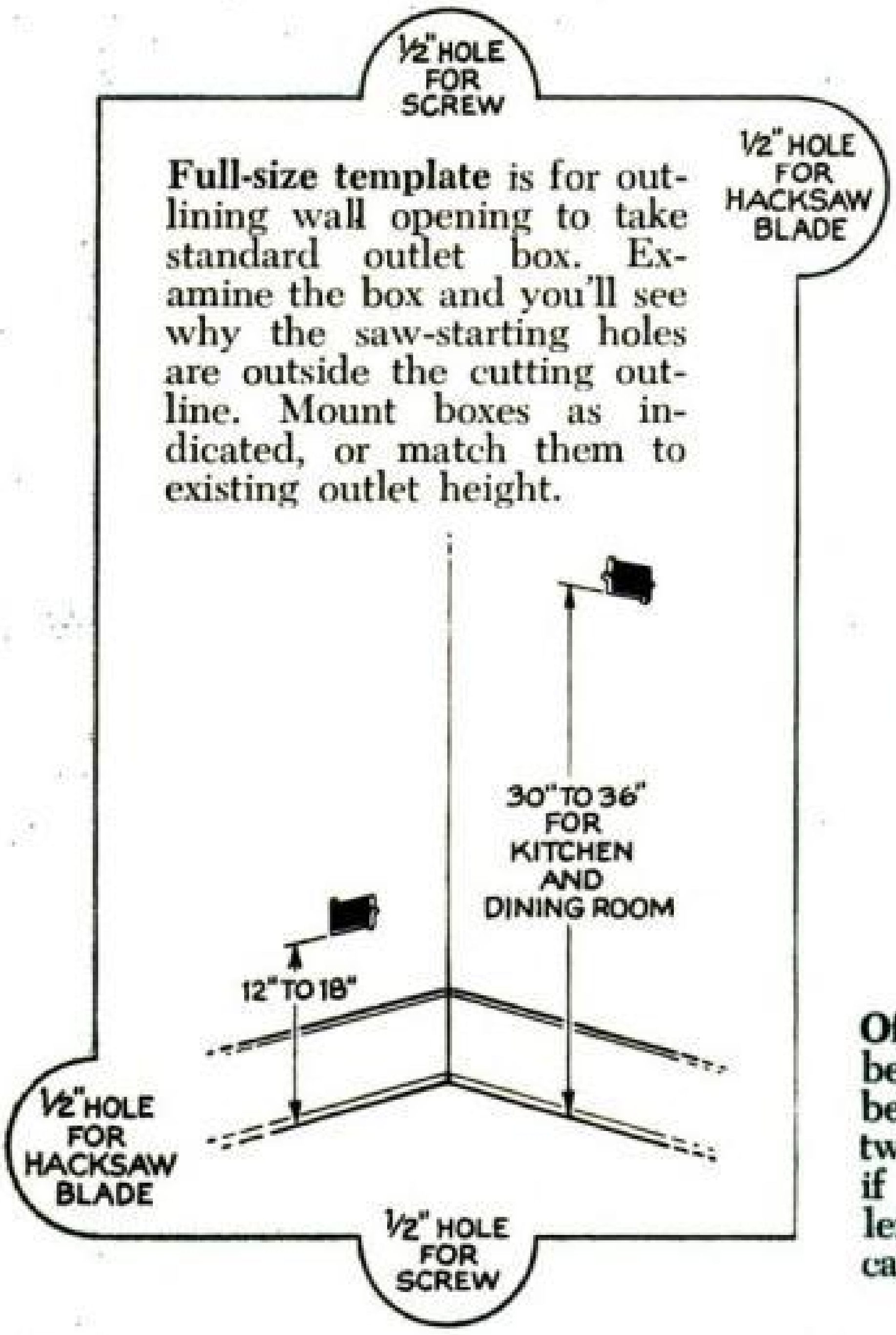
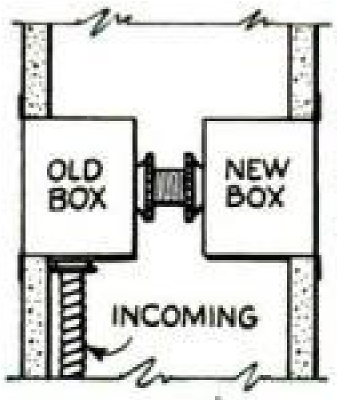
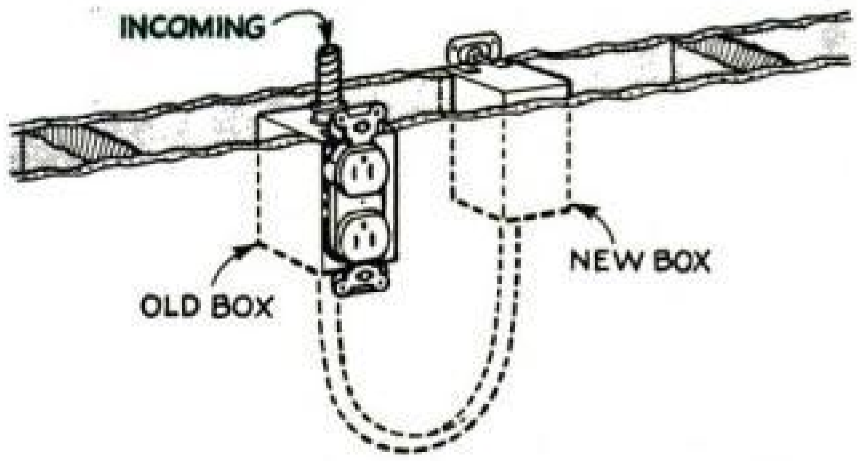


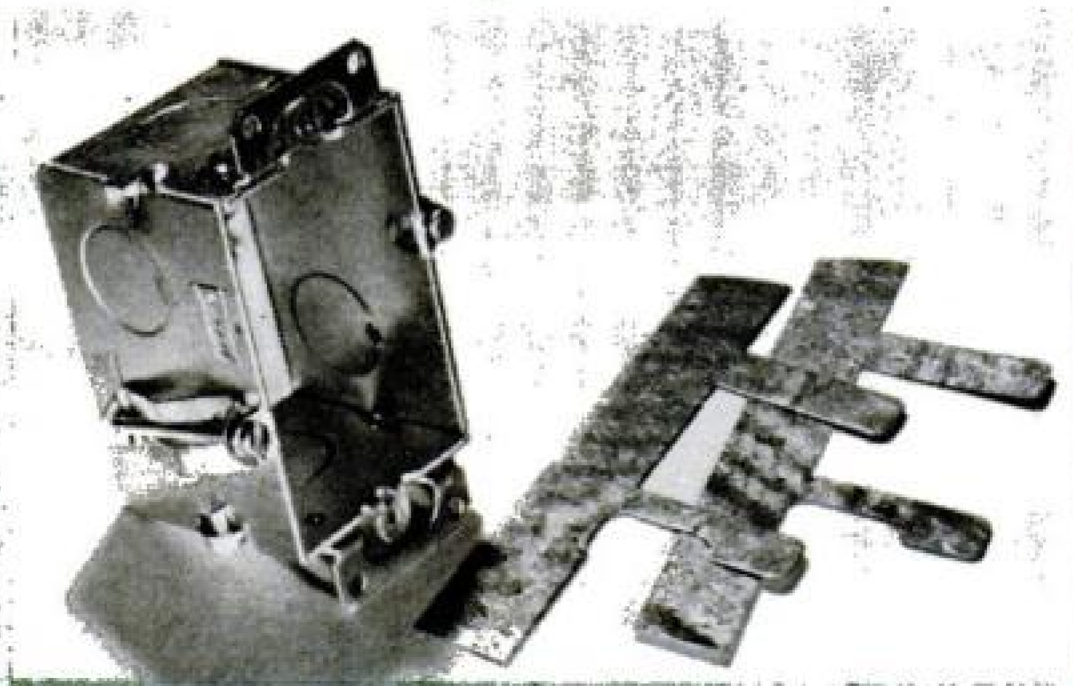
Full-size template is for outlining wall opening to take standard outlet box. Examine the box and you'll see why the saw-starting holes are outside the cutting outline. Mount boxes as indicated, or match them to existing outlet height.

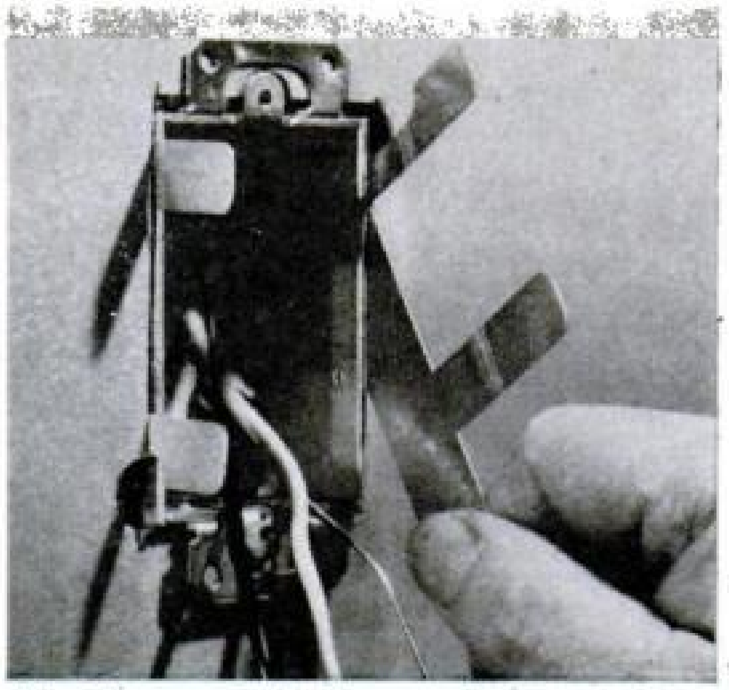


Back-to-back box mounting may be done without cable. Lead black and white wires through threaded nipple between the boxes. Use nut inside and outside both boxes. The easiest way to locate new box position: Remove cover plate from old box, push ice pick through wall next to it.



Offset boxes in opposite sides of same wall can be connected as above. Boxes may be above or below each other but cannot have stud between them. Use nonmetallic sheathed cable, if permitted, as it holds its shape in short lengths when bent, making the job easier. You can also use BX, but the loops will be longer.





Wall-mounting clamps for boxes are made in several types. Box shown at left has them already attached to sides. Tighten screw and clamps buckle out like Molly bolt to lock behind wall. Sheet-metal clamps shown in front of box are slipped in at angle beside standard box (right) and straightened to lock in wall. Protruding tabs are bent inside box.

it bears the UL stamp of approval, and be sure it has a third "grounding" wire in it.

Outlet boxes. These are made in assorted (but standardized) sizes and shapes to suit all the usual wiring needs. You pick the type that suits your wiring situation best. Make sure the connectors or built-in clamps used with it match the cable you will use.

Boxes that are recessed in the wall, as in the living areas of the house, are called flush boxes. Those that are mounted on the surface, as in unfinished basements, are surface-mounted boxes. Flush boxes are usually made with removable sides, the surface models in one piece. By removing a side from each of two flush boxes and

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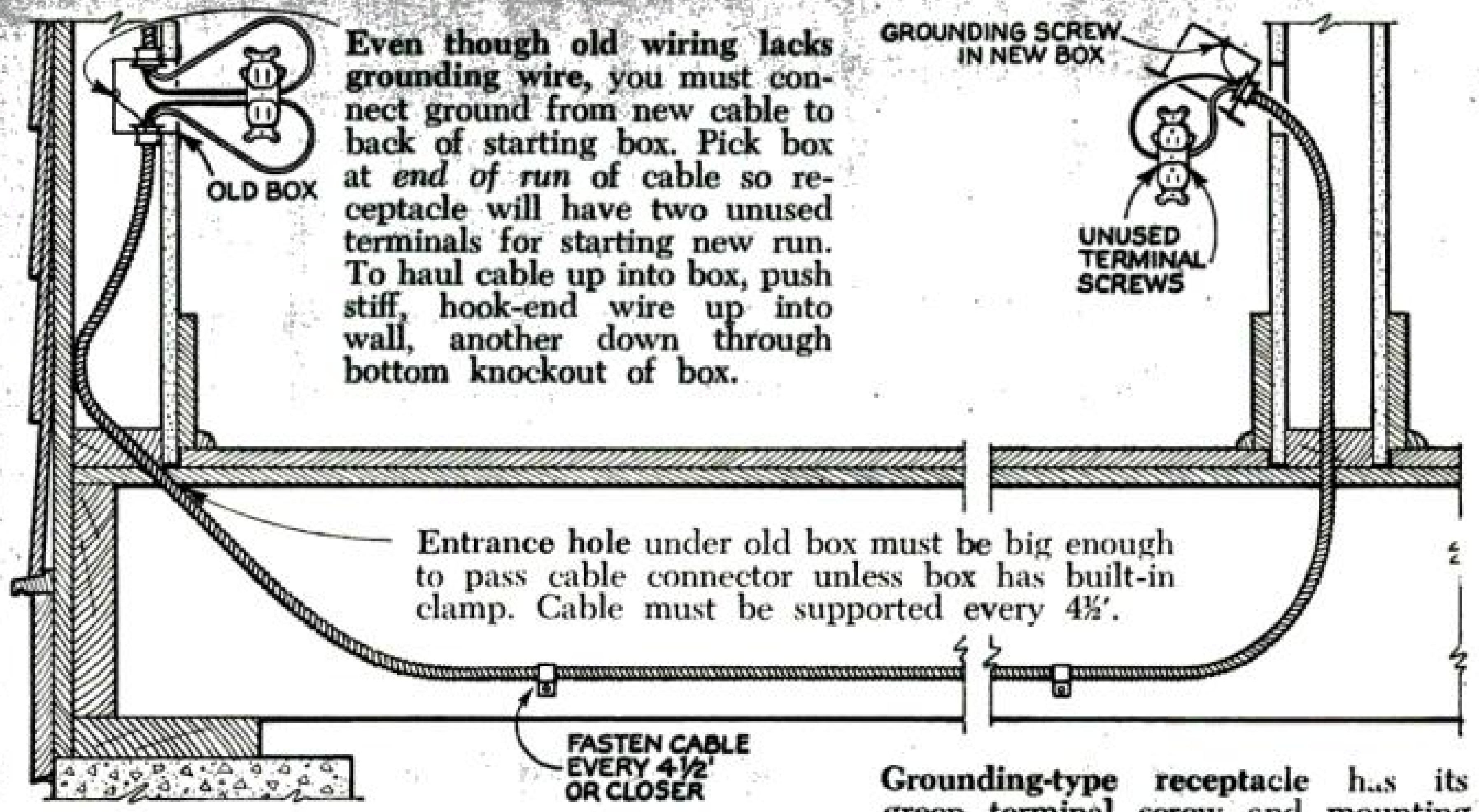
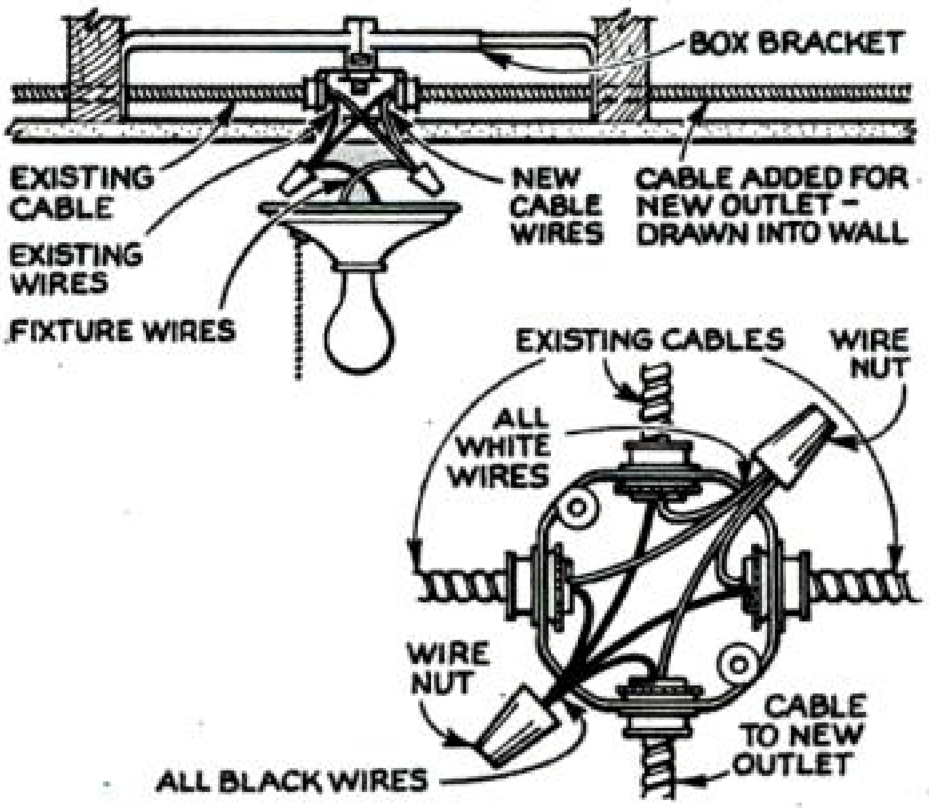
cable to them, and make connections at the receptacles



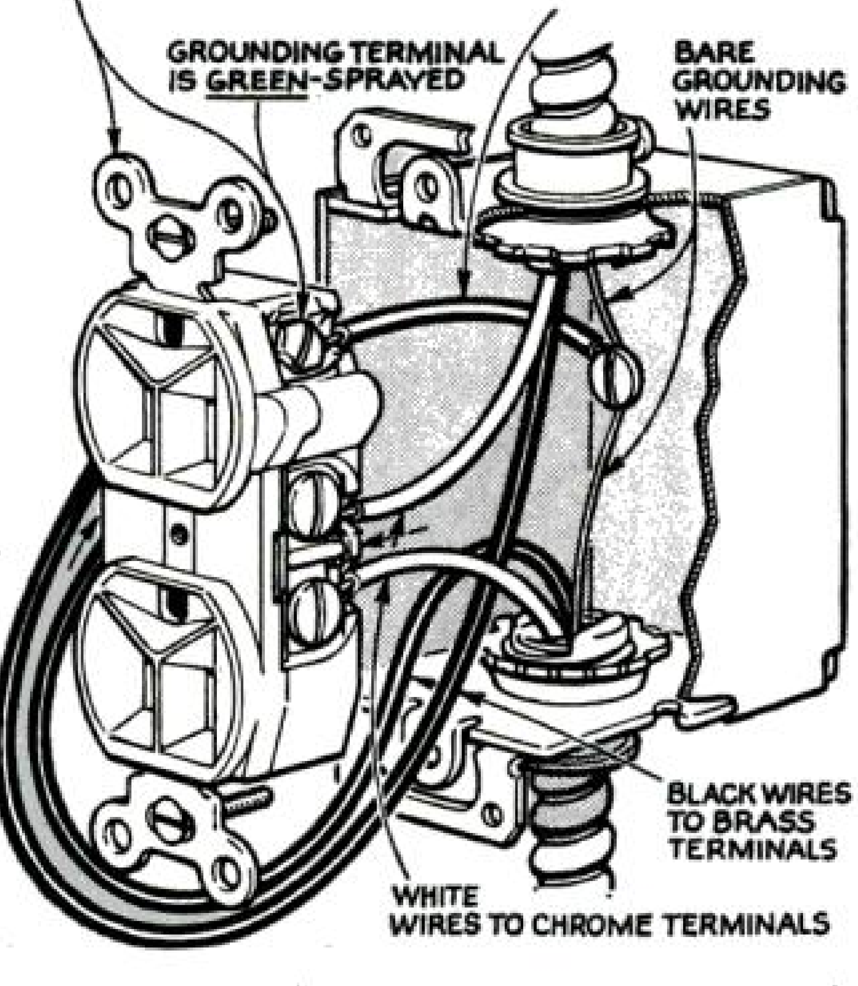
Even though old wiring lacks grounding wire, you must connect ground from new cable to back of starting box. Pick box at *end of run* of cable so receptacle will have two unused terminals for starting new run. To haul cable up into box, push stiff, hook-end wire up into wall, another down through bottom knockout of box.

Entrance hole under old box must be big enough to pass cable connector unless box has built-in clamp. Cable must be supported every 4½'.



From ceiling pull-chain light or junction box your new cable wiring starts like this. To take four two-wire cables, box must be at least 4" octagonal one. Four-inch-square box may take 11 wires. If box contains fittings like fixture stud or device like switch, subtract one wire from permitted number for each fitting or device to comply with National Code.

Grounding-type receptacle has its green terminal screw and mounting ears both grounded. So, in some localities, if the mounting contact is good, a wire from green terminal to back of box isn't required. A good ground contact is a must for safety, however. Receptacle must be removable without breaking cable grounds.



joining the open sides, you "gang" the boxes to make a double-size one that can take twice as many outlet receptacles.

As a general rule, use a full-depth box rather than a shallow one unless limited inner-wall space prevents it. The larger the box, the easier the wiring and the less chance of wire damage when the receptacle is pushed in for mounting. Also, the size of the box determines the number of wires allowed in it. The usual outlet box

[*Continued on page 166*]

NEXT MONTH: Wiring your outdoors

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12 Foolproof Ways to Rig a Fishline

By Hank Bradshaw

A WELL-rigged fish lure is more than just a line with a hook on the end. It must be custom-tailored to the type of waters you're fishing in and to the kind of fish you're after. Personal preference is always a factor, but the 12 rigs shown here represent basic formulas designed and used by good fishermen in a variety of situations from fresh-water trolling to salt-water surf casting. While there are many possible variations, these will serve as a good starting point.

The secret of getting a fishline to do what you want it to lies mainly in how you rig the hardware—the shiny little swivels, sinkers, snaps, spinners, and many other intriguing fittings that are available. The right choice of hardware can make your line do tricks under water that otherwise wouldn't be possible.

By the same token, don't overuse hardware just because it's fun to play with. Too much can scare off a wise and wary fish. Your lure should look and act as natural as possible. Experienced fishermen have a rule: the less hardware, the more fish. In some cases, such as in fly casting, no hardware is used at all and connections are hand-tied to eliminate the need for fittings.

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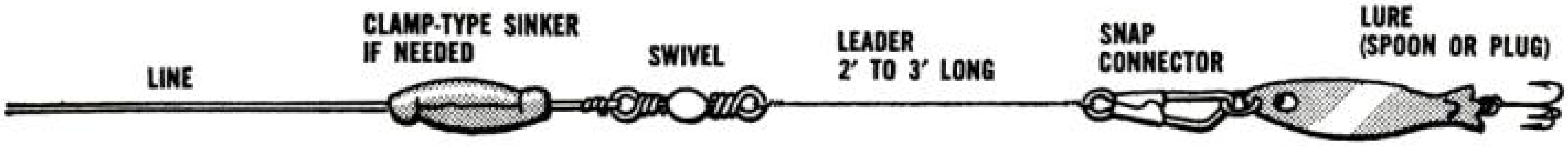
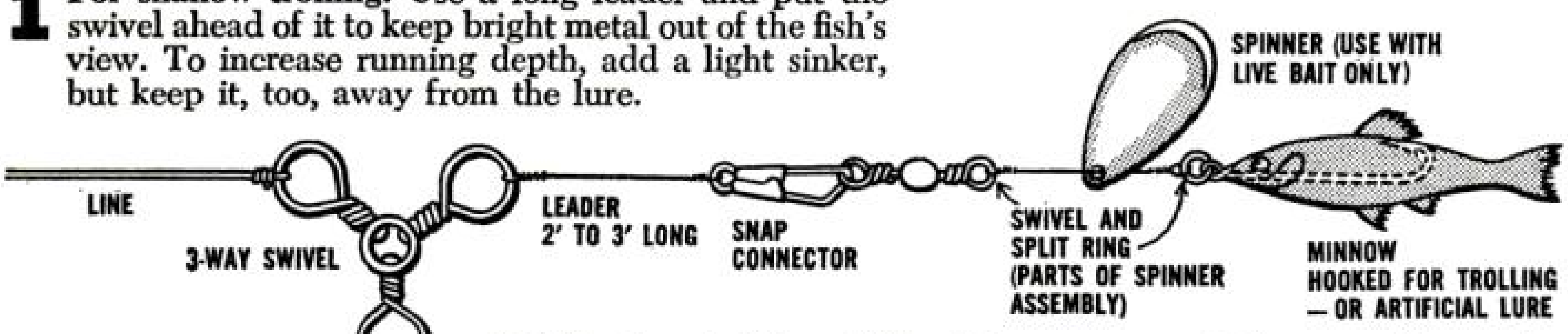
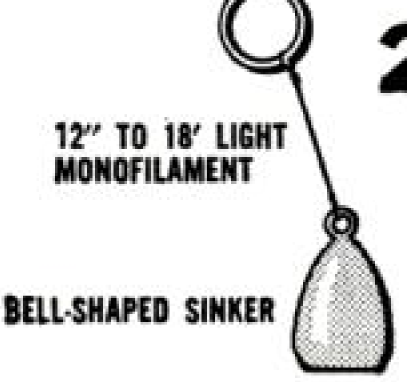
Knowing how to use the



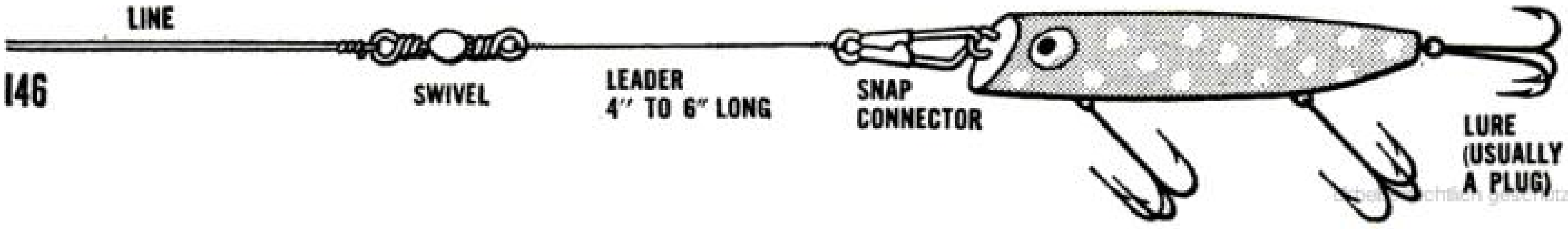
1 **For shallow trolling.** Use a long leader and put the swivel ahead of it to keep bright metal out of the fish's view. To increase running depth, add a light sinker, but keep it, too, away from the lure.





2 **For deep trolling.** Add a sinker on a separate line to pull your rig down deep, but allowing the lure to trail off naturally without being weight-dragged. The sinker should be heavy enough to bounce along the bottom. Use the bell-shaped type with a swivel eye at the top. If you use live bait instead of a plug or spoon, add a spinner to help catch the attention of the fish.

3 **For bait and spin casting.** Use a short leader so you can reel the lure up close to the rod tip—important for good casting control. For fish that haven't sharp teeth, no wire leader is needed.



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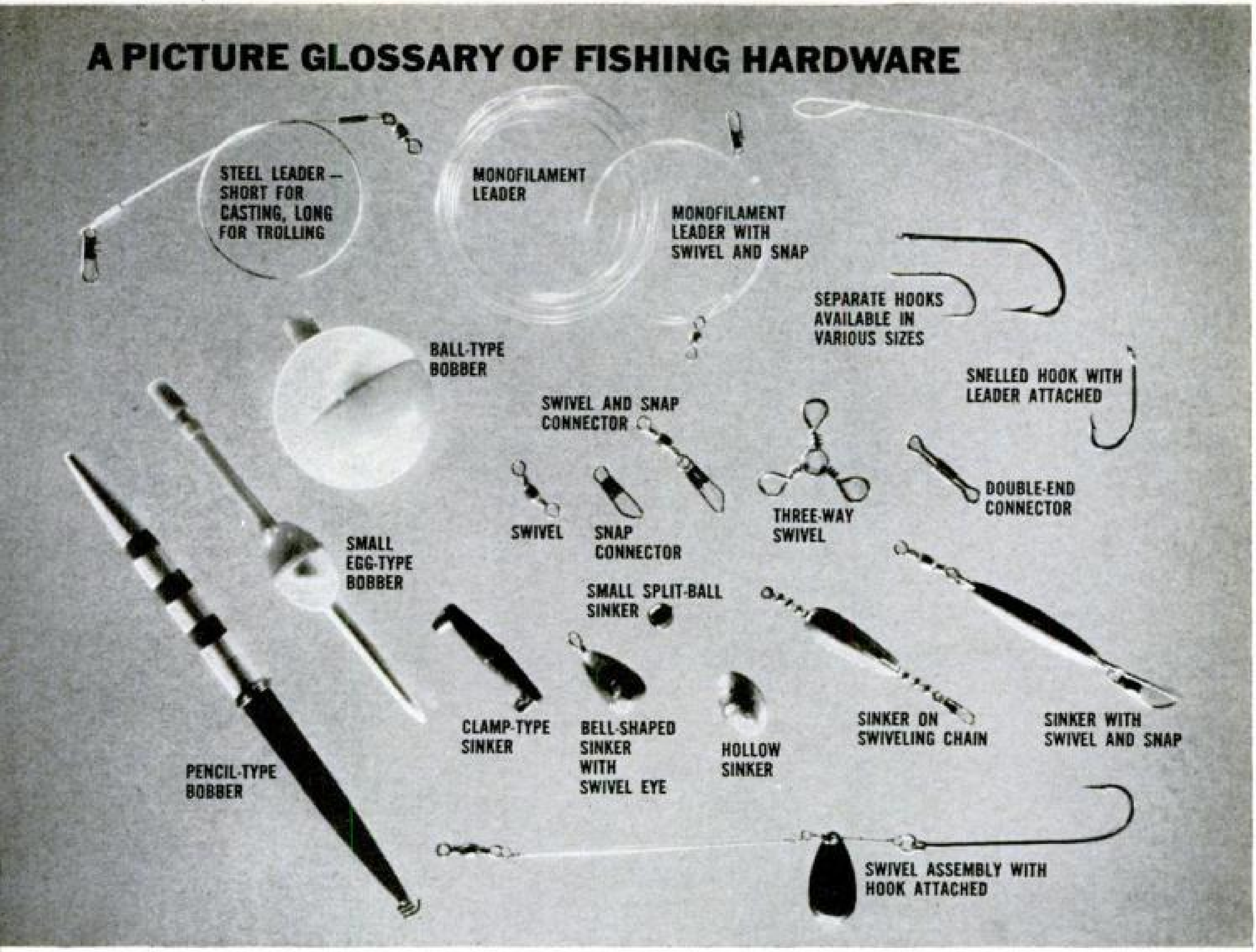
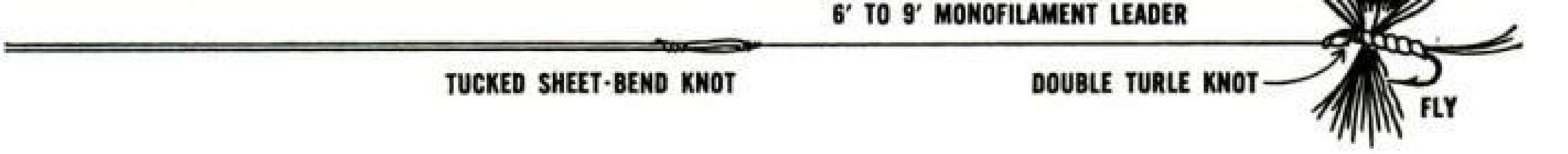
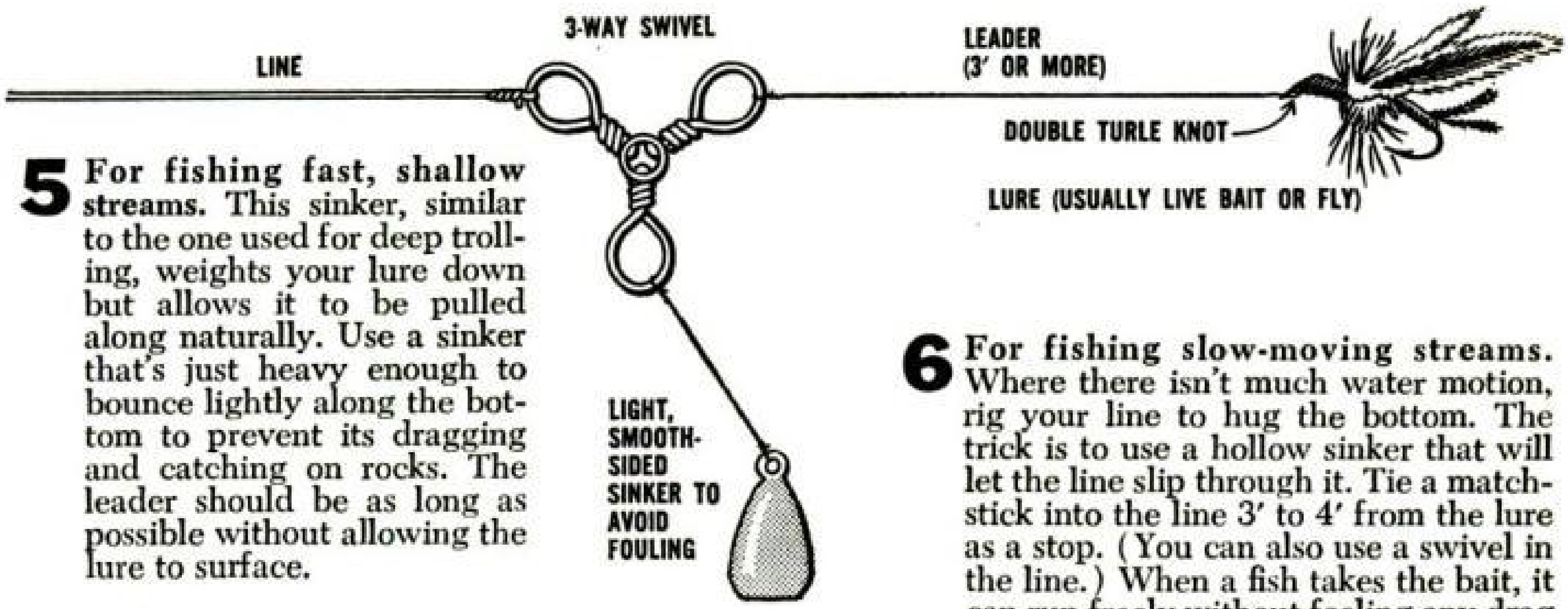


hardware is the secret

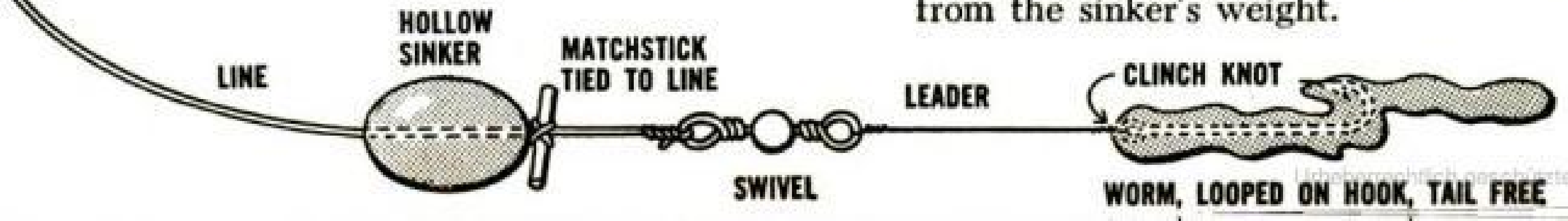
4 **For fly casting.** Light weight and a natural appearance are the keys to success here. Use no hardware, only hand-tied knots. A very long, light leader helps give the lure the actions of a real fly.





5 **For fishing fast, shallow streams.** This sinker, similar to the one used for deep trolling, weights your lure down but allows it to be pulled along naturally. Use a sinker that's just heavy enough to bounce lightly along the bottom to prevent its dragging and catching on rocks. The leader should be as long as possible without allowing the lure to surface.

6 **For fishing slow-moving streams.** Where there isn't much water motion, rig your line to hug the bottom. The trick is to use a hollow sinker that will let the line slip through it. Tie a matchstick into the line 3' to 4' from the lure as a stop. (You can also use a swivel in the line.) When a fish takes the bait, it can run freely without feeling any drag from the sinker's weight.



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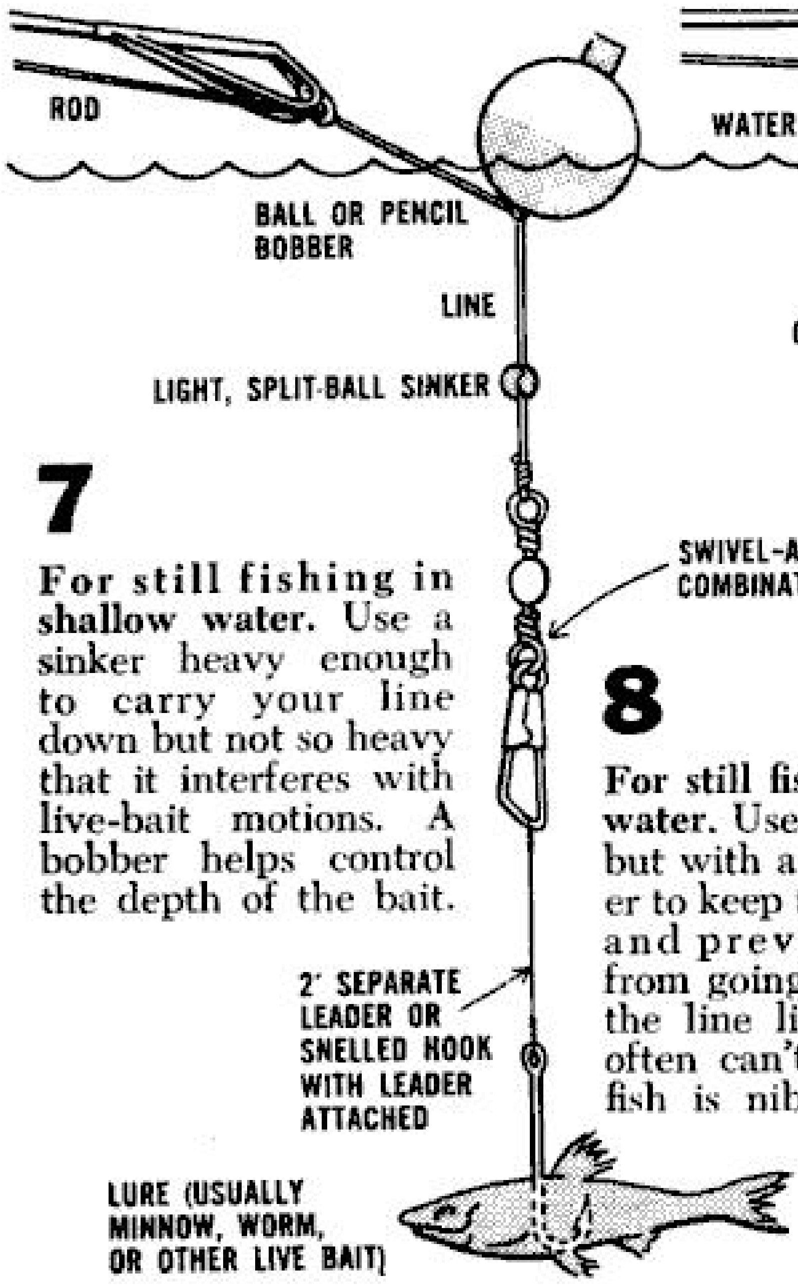
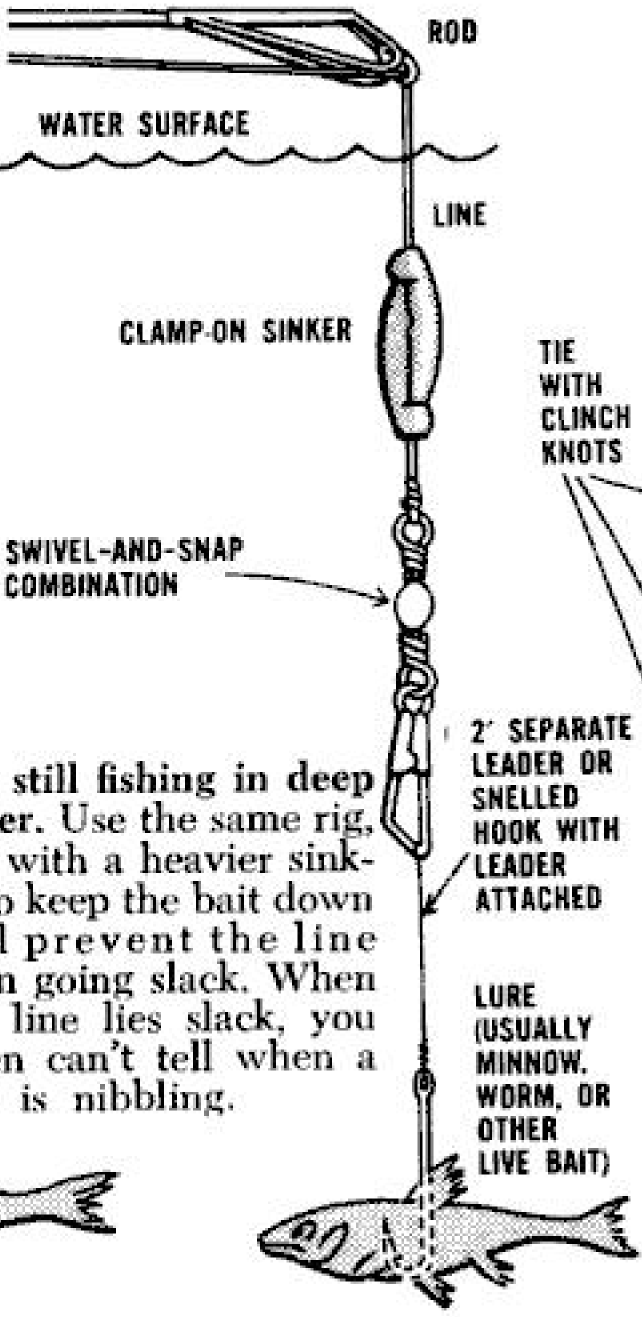


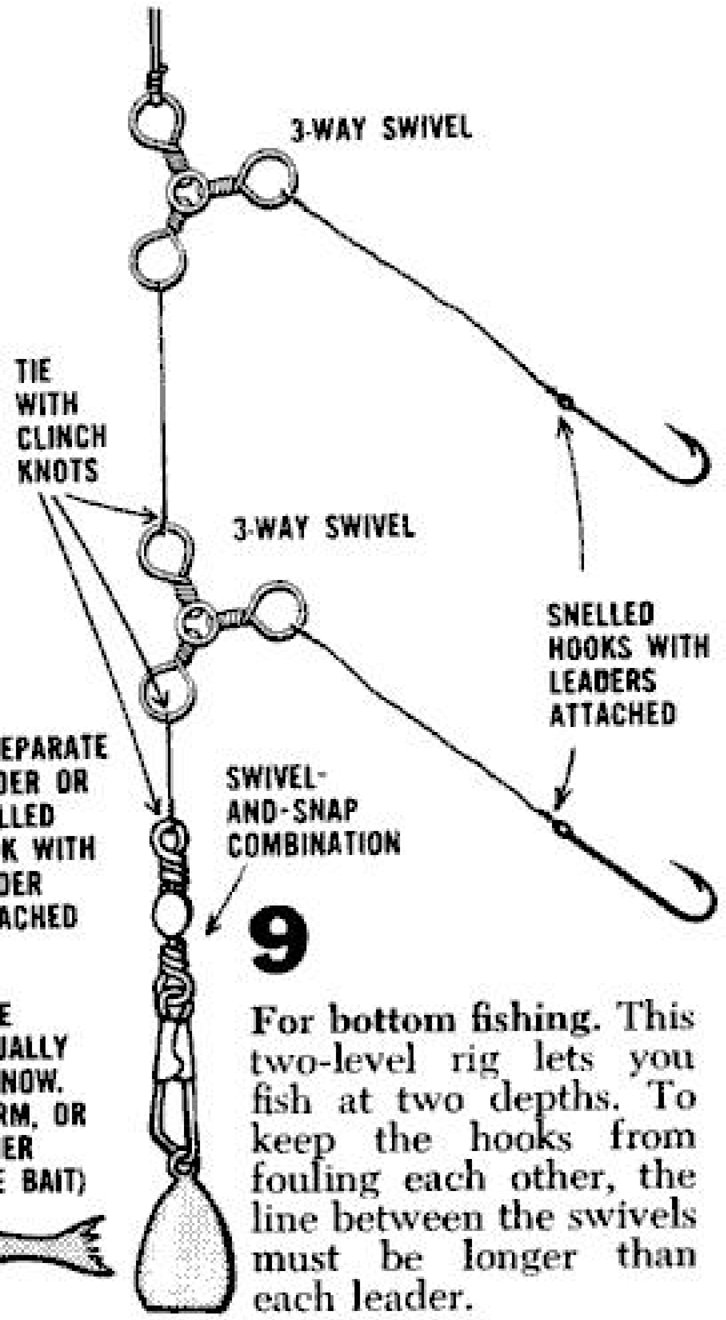
7

For still fishing in shallow water. Use a sinker heavy enough to carry your line down but not so heavy that it interferes with live-bait motions. A bobber helps control the depth of the bait.



8

For still fishing in deep water. Use the same rig, but with a heavier sinker to keep the bait down and prevent the line from going slack. When the line lies slack, you often can't tell when a fish is nibbling.

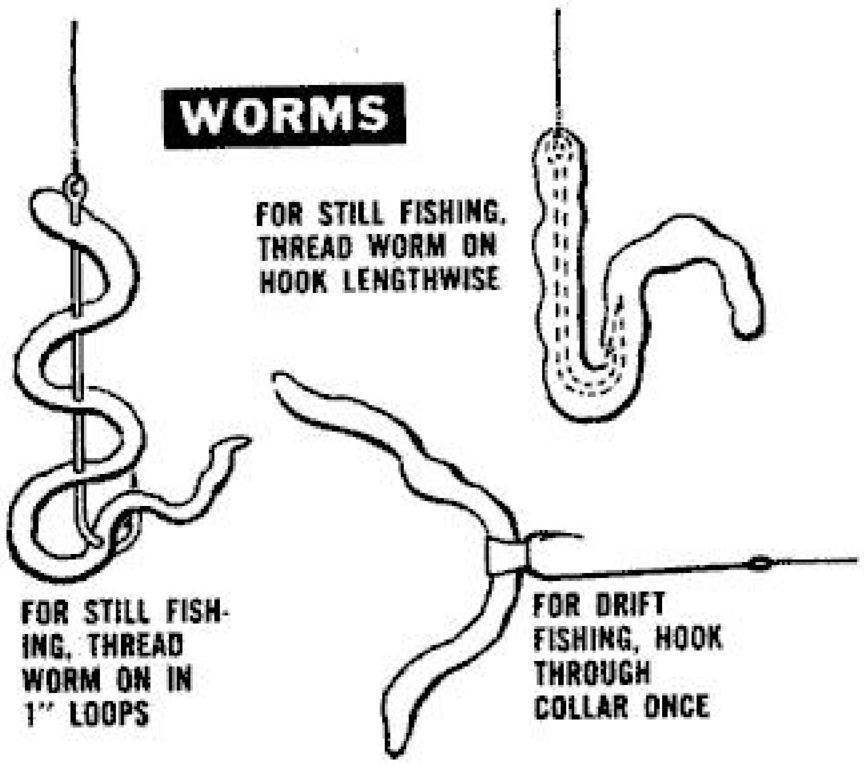


9

For bottom fishing. This two-level rig lets you fish at two depths. To keep the hooks from fouling each other, the line between the swivels must be longer than each leader.

How to hook live bait

WORMS

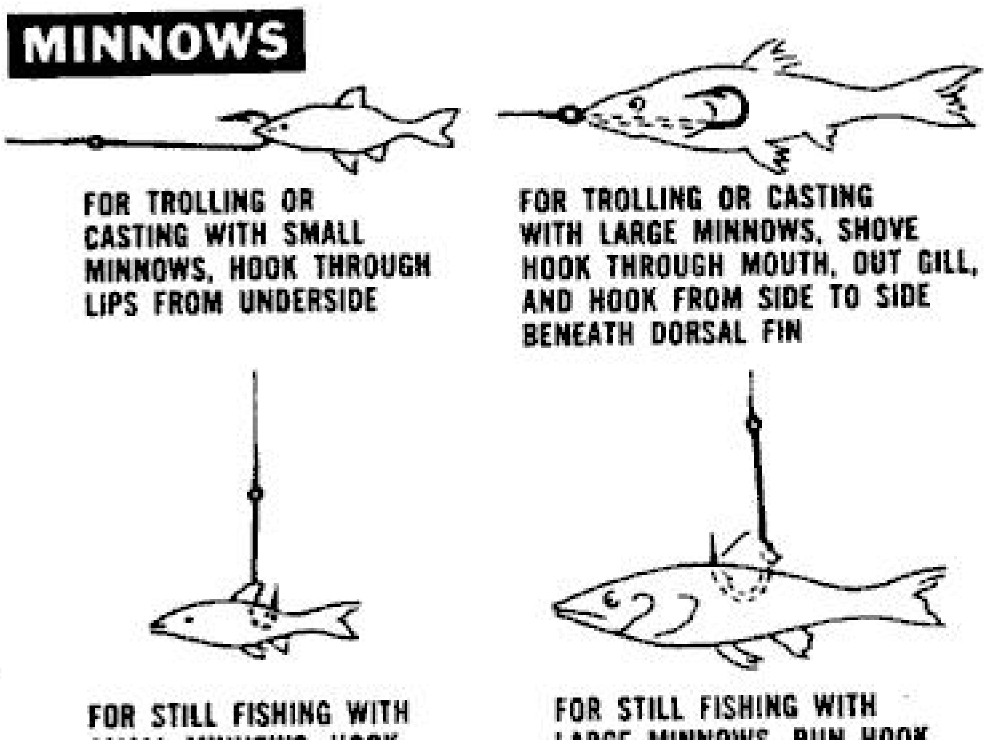


FOR STILL FISHING, THREAD WORM ON HOOK LENGTHWISE

FOR STILL FISHING, THREAD WORM ON IN 1" LOOPS

FOR DRIFT FISHING, HOOK THROUGH COLLAR ONCE

MINNOWS



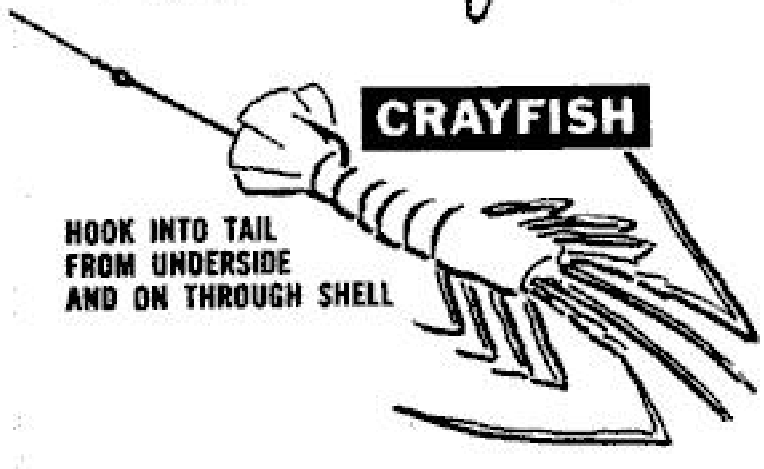
FOR TROLLING OR CASTING WITH SMALL MINNOWS, HOOK THROUGH LIPS FROM UNDERSIDE

FOR TROLLING OR CASTING WITH LARGE MINNOWS, SHOVE HOOK THROUGH MOUTH, OUT GILL, AND HOOK FROM SIDE TO SIDE BENEATH DORSAL FIN

FOR STILL FISHING WITH SMALL MINNOWS, HOOK FROM SIDE TO SIDE BEHIND DORSAL FIN

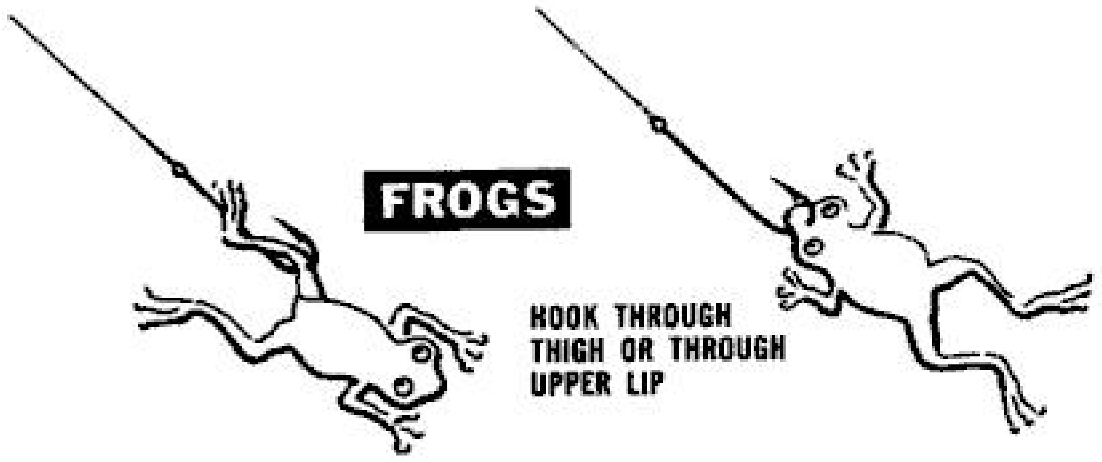
FOR STILL FISHING WITH LARGE MINNOWS, RUN HOOK UNDER SKIN ON ONE SIDE FROM BACK TO FRONT BENEATH DORSAL FIN

CRAYFISH



HOOK INTO TAIL FROM UNDERSIDE AND ON THROUGH SHELL

FROGS



HOOK THROUGH THIGH OR THROUGH UPPER LIP

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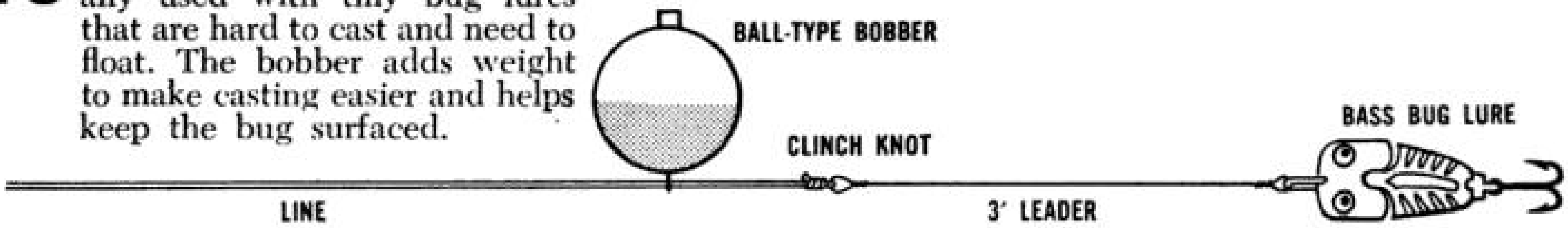
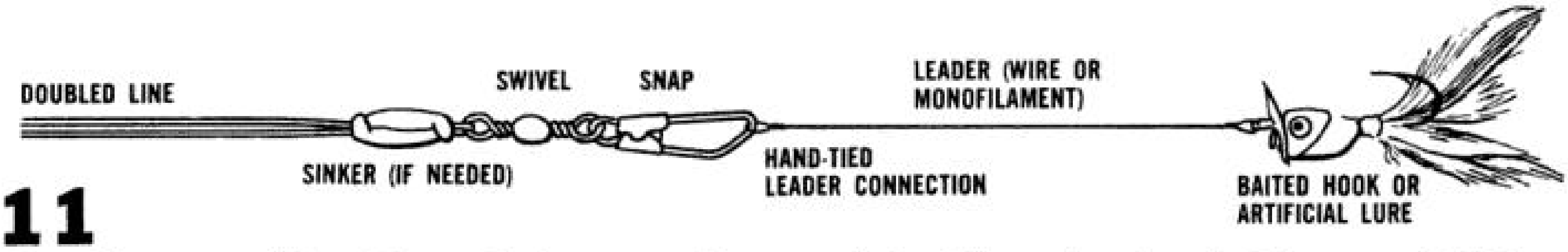
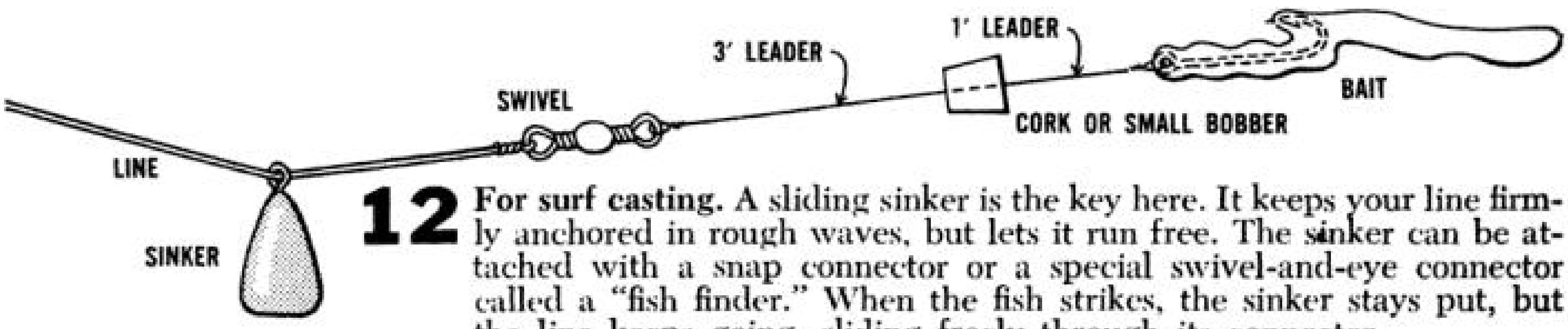


10 **For spin-fishing.** This rig is usually used with tiny bug lures that are hard to cast and need to float. The bobber adds weight to make casting easier and helps keep the bug surfaced.



11

For salt-water trolling. This is the basic rig. For added strength, some anglers double the line for the final 15′ or so. For deep trolling, there's a weighted lead-core line. If more weight is needed, add a sinker ahead of the swivel. If the line twists even with the swivel, add a trolling keel or use a sinker that has a keel built into it. One answer to twisting is good-quality swivels.



12 **For surf casting.** A sliding sinker is the key here. It keeps your line firmly anchored in rough waves, but lets it run free. The sinker can be attached with a snap connector or a special swivel-and-eye connector called a "fish finder." When the fish strikes, the sinker stays put, but the line keeps going, sliding freely through its connector.

What weight line? Most line used today is either braided nylon or almost clear, single-strand monofilament. The braided material lasts longer and snarls less, but the monofilament is less visible under water and sinks deeper—advantages that make it a favorite of experienced fishermen.

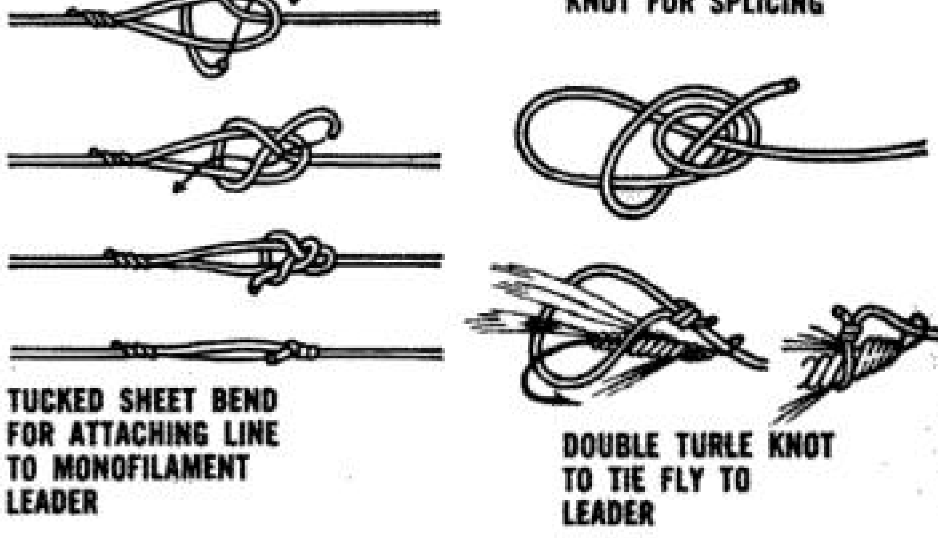
Whatever the type, your line should be no heavier than it has to be to support the kind of fish you are after. The lighter it is, the less visible it will be and the more fish it will entice.

For average fresh-water fish running from three to 10 pounds, lines of eight- to 15-pound test are about right. For salt-water fishing, lines run a great deal heavier. As a rule of thumb, a line's rated weight should always be a little more than the weight of the fish you expect to catch—but not too much more. Most anglers use a somewhat lighter line on spinning reels than on regular bait-casting reels in order to gain the full advantage of the light, free-spinning action.

Choosing the right leader. A leader is a short length of special-duty material between your regular line and the lure. Sometimes you pick a leader that is light, so the fish can't see it. Also, if the fish turns out to be too big for the rig, the leader

[*Continued on page 182*]

Four knots every fisherman should know



Tying knots in monofilament line is more difficult than tying them in braided line. Knots above are specifically intended for joining mono to mono, mono to braided, or flies to mono. Practice ahead, so you won't find yourself out where the fish are and learning to tie knots.

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Gus Puts a Stop to

By Martin Bunn

ON HIS way to get a wrench, Stan Hicks happened to look out the shop door of the Model Garage. Instantly he veered off toward Gus Wilson.

"Boss, I'd like to start my vacation."

Startled, Gus looked up. "Right now?"

Stan nodded eagerly as the murmur of an engine entered the shop. Recognizing the car and its driver, a pretty, middle-aged woman in a fruit-basket hat, Gus grinned.

"The answer," he said, "is no. Get out there and find out what Mrs. Allen wants."

Stan smote his forehead in mock dismay and walked over to the 1964 Ford Galaxie.

With the throttle blocked wide open, Gus inserted the compression-gauge nozzle in the spark-plug hole.

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a Swap

It looked like an ideal trade—a car with more m.p.g. for a car with more hp.—till Gus upset the whole deal

"Morning, Mrs. Allen. Need air? Or a lube job, maybe?" he asked hopefully.

"Oh, no," replied Daisy Allen. "But the car is using more gas than it used to, and before I trade it to that nice Mr. Fleming I'd like you to fix it."

"What makes you think it's using more gas, Mrs. Allen?" asked Stan.

"I have to stop at my gas station more often!" she said triumphantly. "Ever since it ran out of gas two months ago, it takes more than it did before."

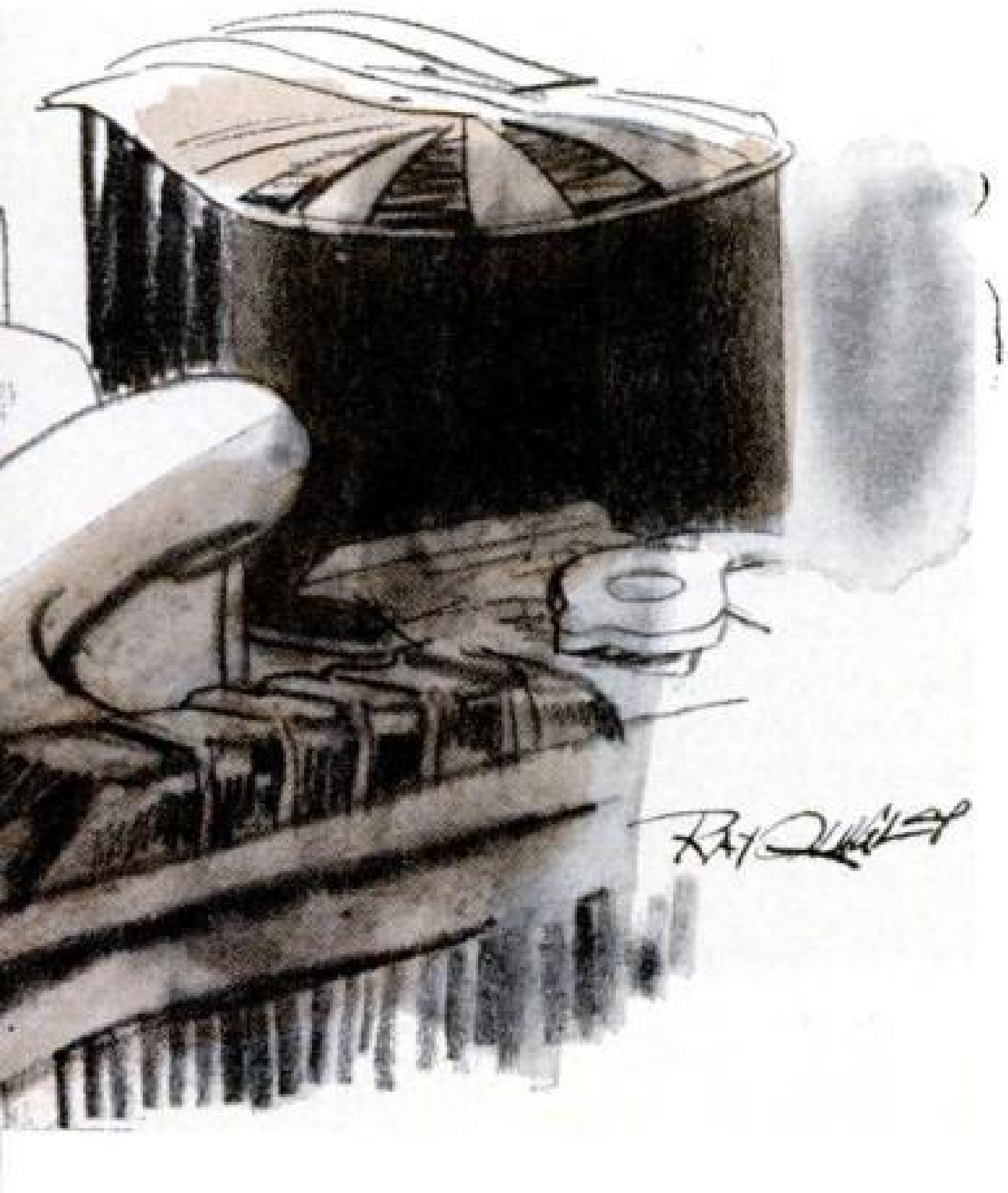
"Maybe you're driving more."

The colorful hat shook vigorously. "Oh, no. All my clubs meet the same days, and I still do my shopping twice a week, at the very same stores. But I *do* have to get the tank filled more often."

"I'll check it out," murmured Stan.

Fuel connections were tight. The fuel pump, fuel lines, and carburetor showed no signs of leakage. The automatic choke was wide open.

Stan attached a vacuum gauge, then rolled out the exhaust analyzer and coupled its pickup to the exhaust pipe. At idle, the needle indicated a reasonable 12:1 fuel-air ratio. At moderate cruising speed, the indication went to a leaner 12.7 ratio. Stan detached the instruments.



"I'd better test-drive it," he said.

"I'll make a phone call meanwhile," said Daisy Allen.

She relinquished the wheel and headed for the phone booth. Stan drove out. The automatic transmission upshifted at the proper points, notched down at the right speed. The engine returned to idle at every stop. He returned to the shop. Mrs. Allen was volubly engaged at the phone.

Driving onto a lift, Stan got the car off the ground and turned each wheel by hand. No brake drag was apparent. Tire pressure was just right. Knowing how Mrs. Allen drove, he didn't believe poor mileage was due to a heavy throttle foot. He lowered the car and hooked up an ignition scope. Its oscilloscope pattern showed the uniform crests characteristic of clean, correctly gapped plugs.

"All those funny little spiked lines," remarked a feminine voice at his elbow. "Are they what's wrong?"

"No, ma'am," said Stan. "They show that your ignition is okay. So is the carburetor and everything else. Your gas mileage should be as good as it ever was."

"But I ran out of gas! Wouldn't that make a difference? Once, when I had a dog, I unexpectedly stayed at a friend's overnight, so he didn't get fed that day. Ever after that he seemed hungrier. See what I mean?"

"Uh—I'll look into it," muttered Stan.

"The friend I phoned is coming to take me to a sale, so you just take your time," said Daisy Allen brightly. "I'll feel better about trading cars if you fix it first."

She fluttered out.

"She *thinks* it uses more gas," grumbled Stan, "because it ran out once."

"Could be," remarked Gus.

"Aw, no, Boss. Not you, too!"

"It wouldn't be the first time Daisy Allen told us where to find the trouble," said Gus. "Like the tank, maybe."

CONTINUED

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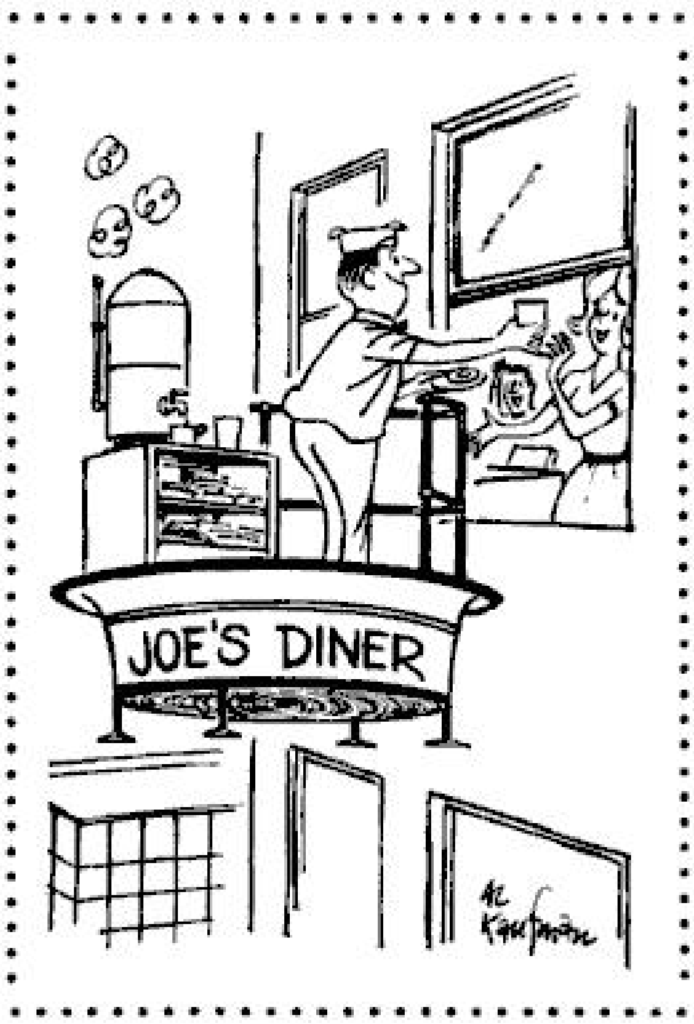
Without a word Stan got a crawler and rolled under the car. He was back quickly.

"The tank bottom's caved in," he said in a thin voice. "It doesn't hold as much. She *did* have to fill up oftener."

"Uh-huh. Bet you she says 'fill it up' and 'charge it,' so she doesn't realize that she's buying less gas each fill," said Gus. "And her gas gauge probably shows about a quarter of a tank less than it should—all since she ran out of gas."

"You're kidding!"

Gus shook his head. "No, that happens with '64 Mercs and Galaxies. So long as the fuel pump pulls gas, the cap vent is big enough to let in enough air. But when gas runs low and the pump begins to draw air, the vent can't let air in fast enough. Pump suction then pulls up the bottom of the tank. That buckles the fuel-level sending mechanism. Afterwards, the gauge reads an eighth to a quarter of a tank lower than the true level."



"I'll put in a new sending unit," said Stan, "so the gauge'll read right. But I won't have to explain the whole thing to that goof—to Mrs. Allen, will I?"

"You sure will," retorted Gus, "unless you blow out the dent in that tank. If you don't, she'll still have to stop for gas more often than before, and she'll be back to tell you so. To make sure the tank doesn't collapse again next time she runs out of gas, you better drill some extra vent holes in the cap."

Disconnecting the fuel line, Stan plugged the opening, then wrapped cloth around the nozzle of an air hose to make a tight fit in the filler neck. Cautious application of air pressure eventually resulted in a clanging pop. He inspected the tank again. The dent remained only as a ghostly outline.

After reconnecting the fuel line, Stan removed the sending unit. Its float linkage was deformed. He put in a new unit, and the gas gauge promptly read higher. In the brass diaphragm under the filler cap he drilled two 1/16" holes. They would admit enough air to prevent pump suction from collapsing the tank again.

An hour later, Mrs. Allen was back inquiring about her car.

"It checks out fine," said Stan. "You won't have to stop for gas so often."

"Oh, that's just wonderful!" she said as she turned on the engine. "You didn't put in any gas, did you?"

"Not a drop, ma'am," replied Stan.

"Well, then you've certainly done a fine job of making it use less. The gauge already shows more than it did when I came in."

Stan swallowed. "But how could—yes, ma'am," he amended quickly. "That's what I meant when I said it checks out."

It was near closing time when a 1963 Chevrolet six drove into the shop. The man who got out was tall and had a prominent Adam's apple. Sad eyes and flabby jowls gave him the lugubrious look of a bloodhound.

"I know it's late," he said apologetically. "But can you spare a minute?"

"Of course," said Gus.

"My name's Jeff Fleming. I live near the Allens, who're customers of yours. I'd been wanting a more powerful car, and my wife must have told this kookie dame—I mean Mrs. Allen. She came around a couple of days ago and said her car was using too much gas, so she'd trade it for mine and a cash difference. Before I say yes, how much would a valve-and-ring job cost on mine?"

Gus consulted a rate book and gave Fleming an estimate.

"Well, I don't know," the man mused. "It wouldn't be a bad deal, even if I paid that and the difference she asked. But it would cost more than I first thought. Maybe I'd better forget the deal. Anyway, it could be risky—dealing with Daisy."

Gus opened the hood. The engine was clean, the whole car well cared for.

"What makes you think it needs a valve-and-ring job?" he asked.

Fleming massaged his throat. "I saw this '64 Ford I liked at a dealer's. He talked a pretty fair trade-in figure, but then wanted to try my car out. After he did, he said it had no pep and chances

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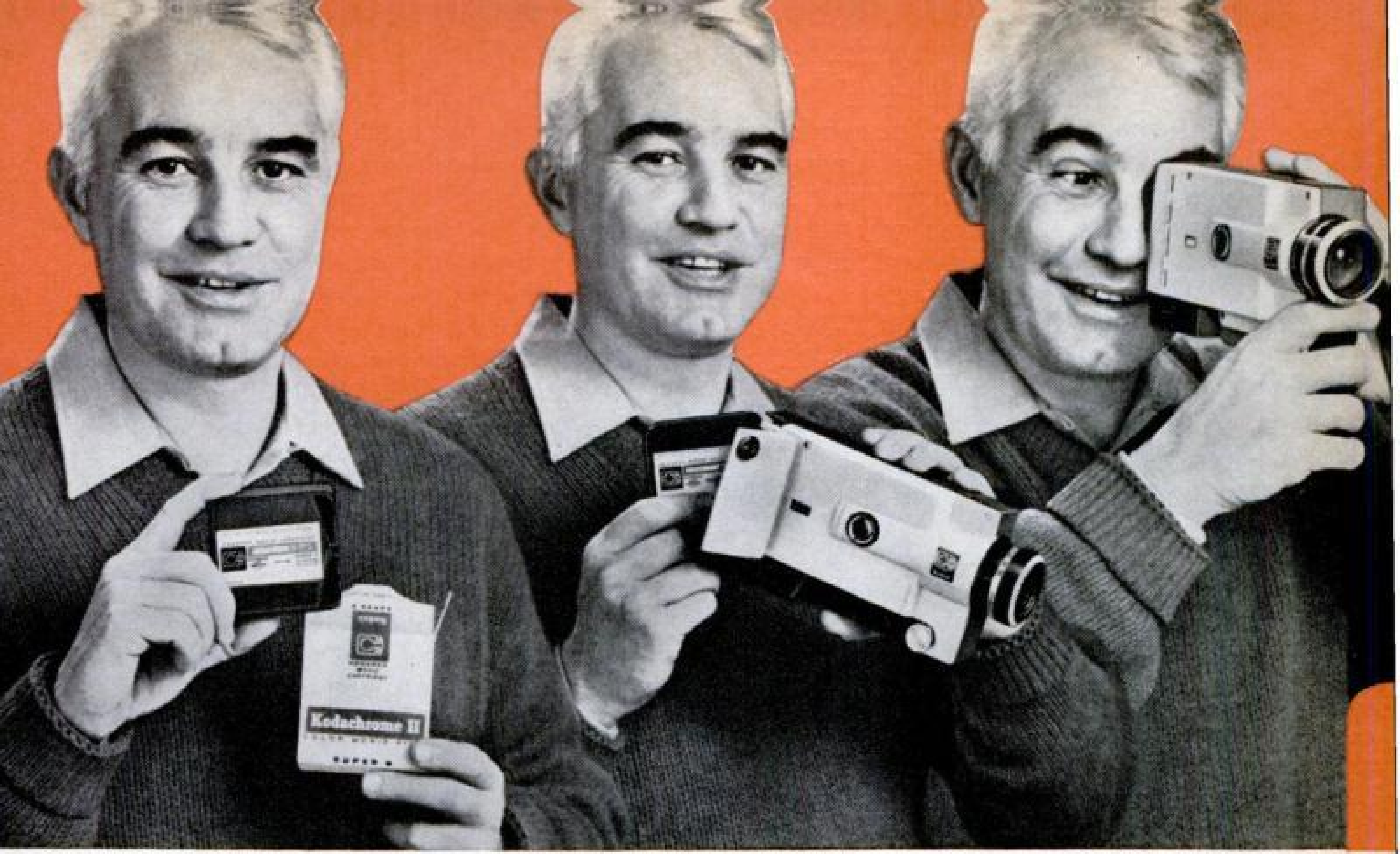

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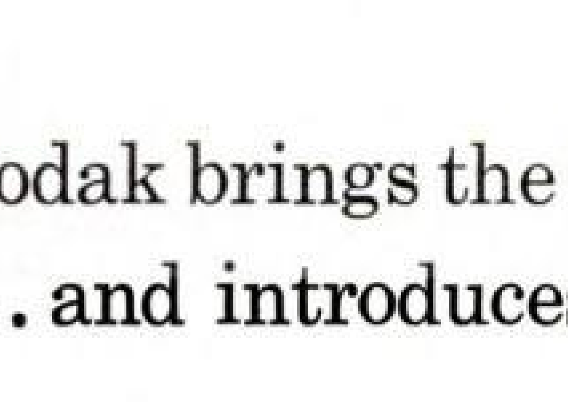

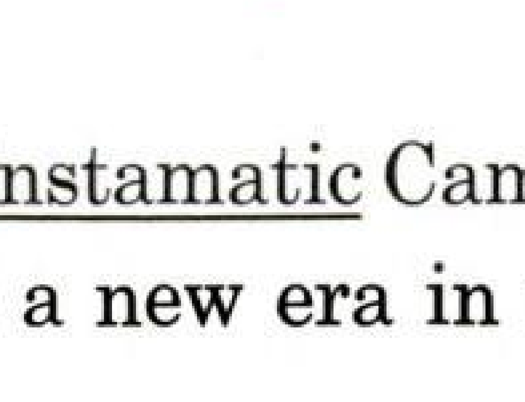

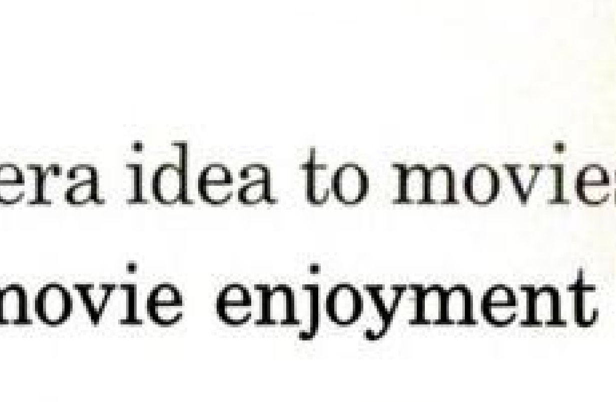

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Kodak
TRADEMARK

were the compression was poor, so his mechanic would have to check it.

"The mechanic took out the spark plugs and turned the engine over with a gauge in the plug holes. He wrote down what it said, I was watching and here's what it read."

Gus took the smudged card he was offered. The penciled figures read:

Cyl 1–76, Cyl 2–160, Cyl 3–162,
Cyl 4–160, Cyl 5–110, Cyl 6–62.

"The dealer asked me what I thought of an engine with low compression in three cylinders. He explained the highest and lowest shouldn't be more than 20 pounds apart."

"He's right there," admitted Gus.

"Yeah. He said the motor definitely needed a carbon-valve job and most likely a ring job, too, so he took 200 bucks off the trade-in figure. It would be different if I traded the car to a stranger, but this Allen woman—well, she's a friend of my wife's. Besides, it would be like taking candy from a baby," concluded Fleming.

"Suppose I make a compression test?" suggested Gus. "Might find out whether it's just valves, or if you need a ring job."

Fleming agreed. Gus pulled off the spark-plug wires and loosened each plug one full turn. He started the engine at a fast idle. Turning it off after a short run, he removed the plugs and the air cleaner. With the throttle blocked wide open, he inserted the nozzle of a compression gauge in the number one cylinder, and using a jump switch made the starter turn the engine over several times.

The gauge needle went to 158 pounds. On number two cylinder it hit 162, on three 161, on number four 160, on number five 154, and on number six 155 pounds.

Fleming's eyes popped. "Hey, did you fix it just by loosening the plugs and running the engine?"

"Didn't the other mechanic do that?"

"Uh-uh. He just took the plugs out."

Gus shook his head. "Unscrewing them usually loosens bits of carbon. If just one gets under a valve, it can hold it open and give you a low compression reading. That's why we break the plugs free first, then run the engine so it will blow out any loose carbon particles."

"I'll bet that dealer knew that."

"I guess he did," chuckled Gus. "But your compression is okay in all cylinders. If it were low in any, we'd pour in a little oil and check it again. If the reading came up, that would mean worn or stuck rings. If it stayed the same, we'd suspect sticking or leaky valves."

"Guess I can trade with that woman after all," said Fleming. "How much do I owe?"

Gus replaced the plugs and their cables, and made out a small bill.

Early next morning Fleming walked into the shop, his doleful face longer than ever.

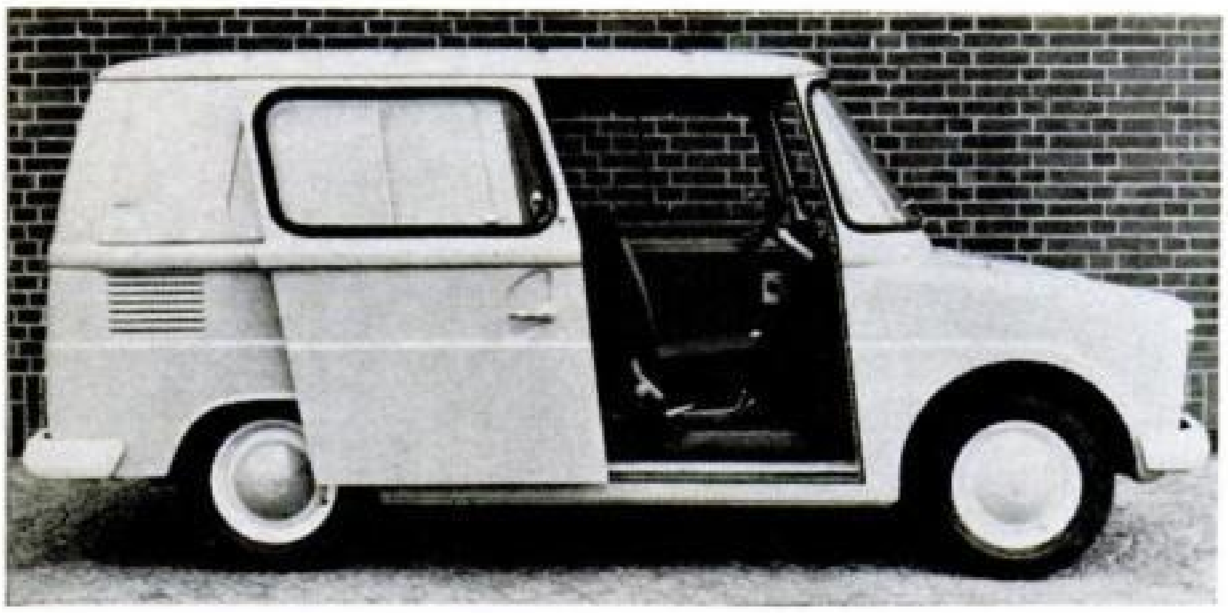
"Morning," greeted Gus. "Your car okay?"

"Yeah," was the glum reply. "It's outside. I just want to ask you a question. Mrs. Allen told me you did something to her car that put gas back in the tank. Did you, or is she mixed up as usual?"

"Partly," agreed Gus. "But the gauge did read higher. Stan here can explain how it happened."

Stan did. "She wanted it fixed so you wouldn't be getting a lemon. The car's all right. You needn't be afraid to trade."

"Who's afraid?" returned Fleming morosely. "When I went over to close the deal, it suddenly hit her that since the bum gas mileage was fixed, and that was her only reason for swapping, why should she trade for an older car? The deal's off. Like I told my wife, that Allen dame may be kookie, but she's not so dumb." ■■



Volkswagen pickup truck

Mounted on a Volkswagen 1200 chassis, the body of the little pickup at left was built in Westphalia, West Germany, by Franz Knoebel and Sons in cooperation with the VW factory in Wolfsburg. Thirteen feet long and 5¼ feet wide, it has a rear cargo door and sliding doors at the sides. The truck's 40-hp. VW engine gives it a top speed of 62 miles an hour.

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Hints from the Model Garage

A low-cost trouble light is easy to make from an old auto head lamp. It doesn't matter if the low beam is burned out, but the high beam must be okay. Remove the plug end from a 20-foot extension cord, thread the cord through a hole (punched with a hot nail) in the bottom of a plastic drinking glass for a handle. Push socket on to the lamp connections; then knot the cord to hold the glass in place and secure it with plastic tape. Attach a cigarette-lighter plug to the other end of the cord.

To mask chromium emblems or other trim before painting, put some grease on your finger or use a small brush to cover the parts you don't want painted. After spraying, wipe the grease off. Clean the area with a detergent when the paint dries.

When installing an oil-filter element in a top-cover or shell-type casing, be sure to hold the cover or shell tightly in place while tightening the center bolt. If you keep the shell from turning, the gasket will seal and assure freedom from leaks.

CONTINUED

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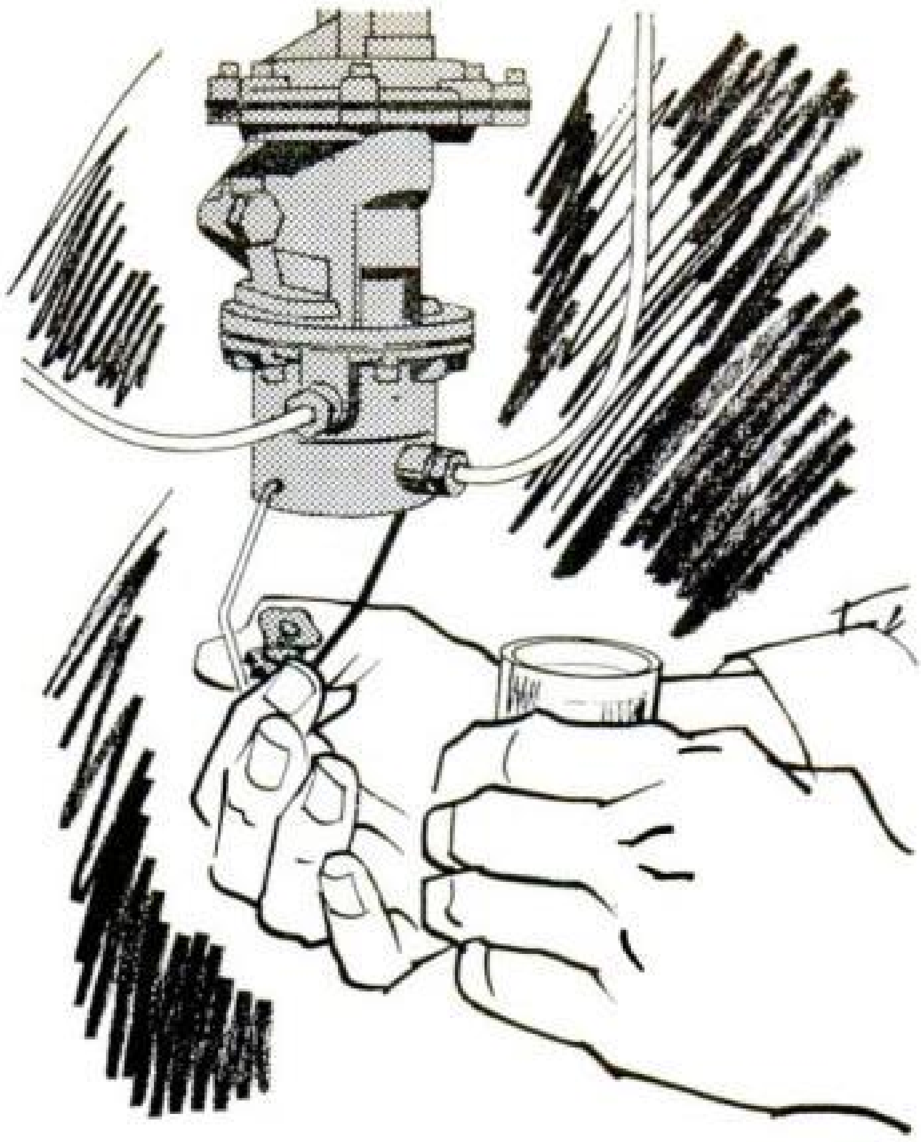
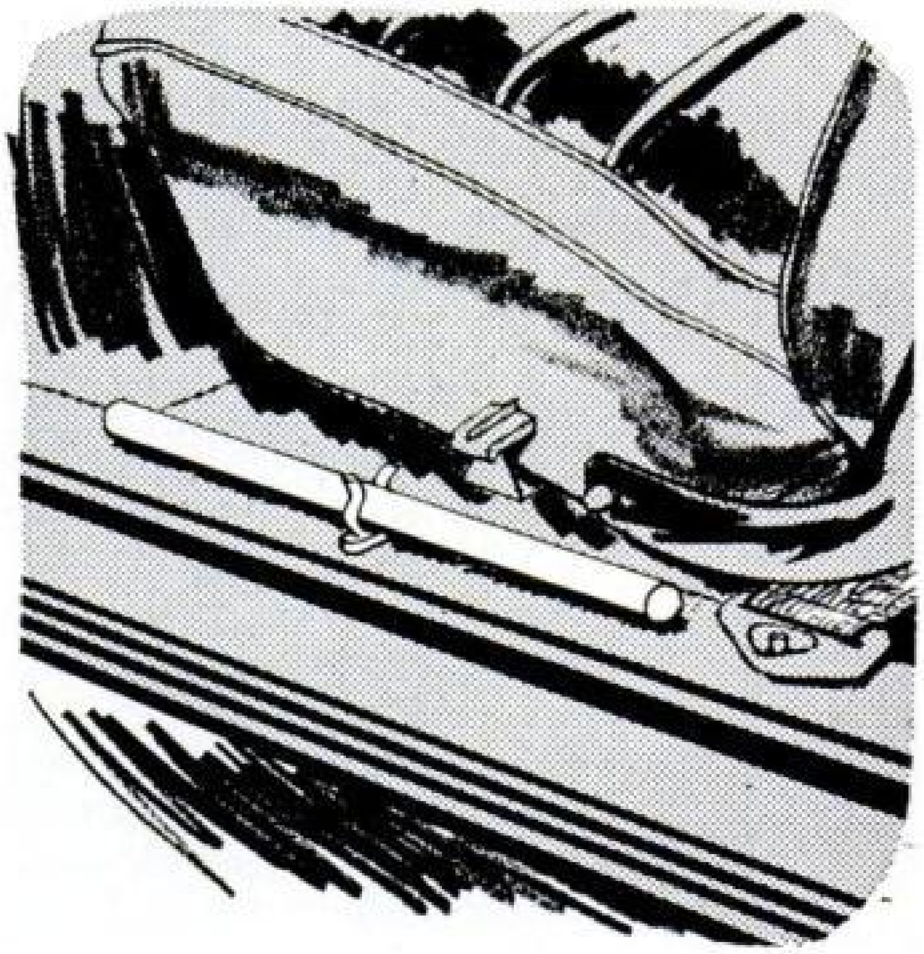
Road-map distances are easy to tally by shaping a piece of 1/16" solder to follow the highway. Indent the solder with your fingernail to show the start and end of the route you are plotting; straighten it and put it on the map scale to read mileage.



On cars with sediment bowls at the bottom of the fuel pump, the easy way to disconnect the fuel line on the pressure side of the pump is to remove the bowl. In this way, the engine can be turned over without risk of gasoline running all around.

Loose packages in the trunk won't rattle around if you tie them down by means of marine cleats on the trunk walls. Fasten the cleats with self-threading metal screws. Ordinary twine will hold the packages. Marine-hardware stores carry the cleats.



Keep your road flare handy for an emergency by fitting a broom-closet clip on the door sill next to the driving seat, as shown above. One clip is usually enough to hold the flare in place, but two may be used if there is enough space for them.

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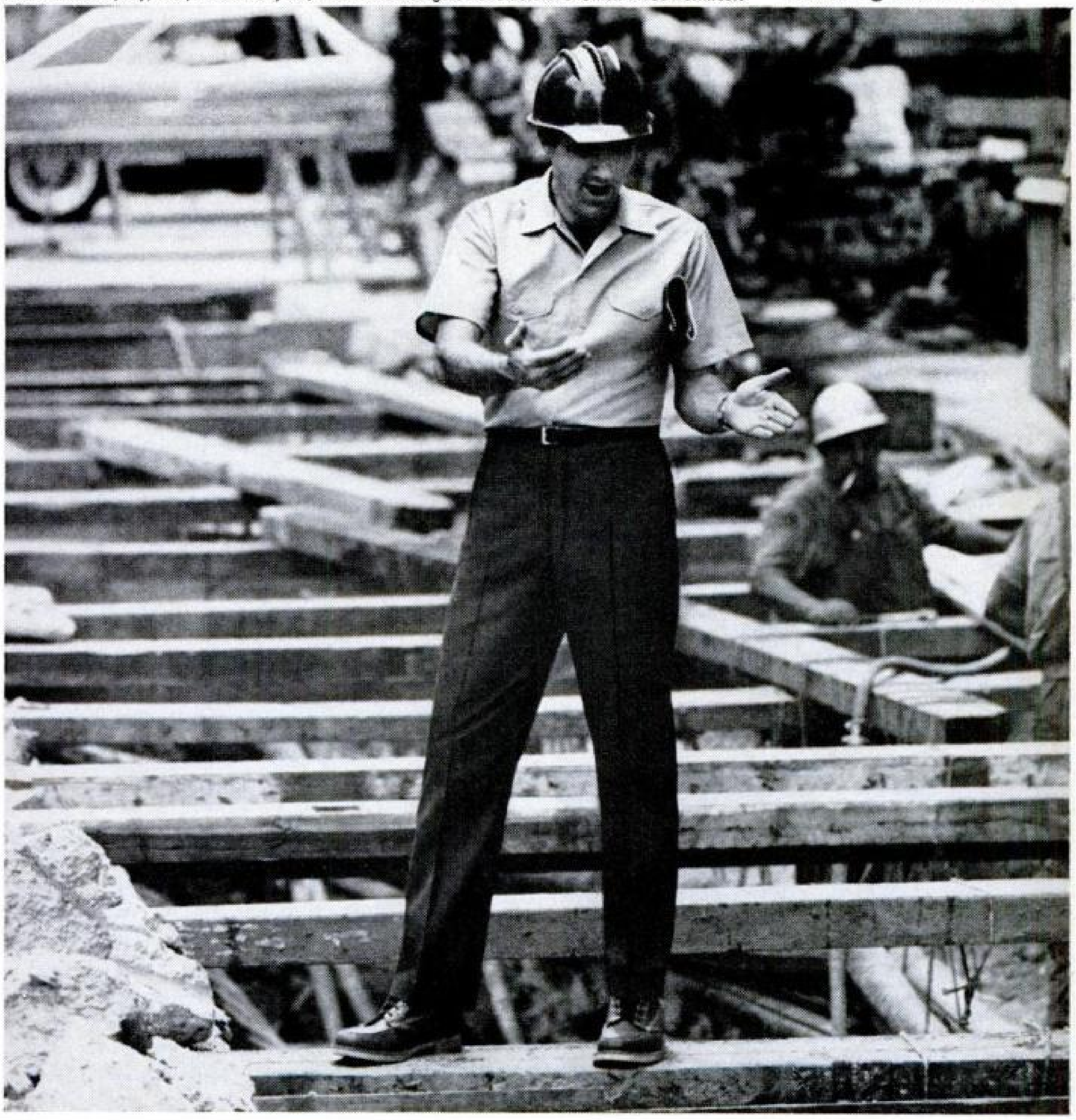


[Continued from page 92]

now skirmishing among themselves, disputing about light-metering systems.

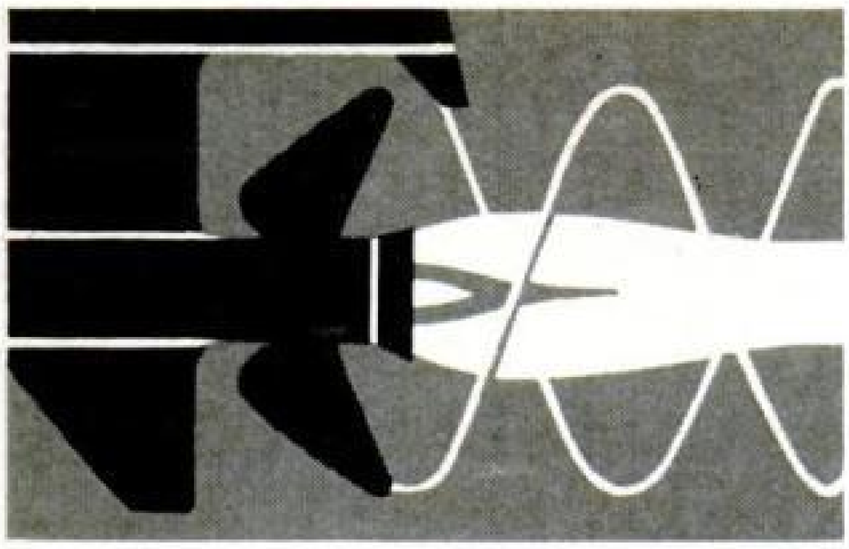
The Beseler Topcon started this fight by introducing the first behind-the-lens metering system, a method that measured only the light coming through the lens to the film. The Pentax Spotmatic followed with its own method of metering light behind the lens. Now, at IPEX, more cameras of this type have appeared, among them: an economy version of the Topcon, the Auto 100, priced at $160; the Canon Pellix (of which, more later); and the Nikomat FT, made by the Nikon people. This will sell for about $270 (with an *f*/2 lens), and no one will be surprised if the next model of its flossy cousin, the Nikon, emerges with a similar light-reading system. In fact, no one will be surprised if almost all SLRs adopt behind-the-lens metering systems within the next couple of years.

New cameras. Among cameras of larger format, the most notable new one is the Graflex XL, latest of a long and famous series to bear the name. Like the Hasselblad and Bronica, with which it will compete, the Graflex XL is more of a system than a camera. Different backs enable it to use sheet film, roll film, or Polaroid film pack, and take either 2¼-by-3¼ or 2¼-by-2¼ pictures. Eight lenses are available, from 58mm wide angle to 180mm telephoto. Cost: from $400 for basic camera body, lens, and back. For the complete system: about $2,400.

A competitor for Polaroid has also appeared: the Crislin Insta-Camera. A disposable cartridge houses both film and developing chemicals. After taking the picture, you pull a film tab, which moves the exposed film into a developing tank in the cartridge. Sixty seconds later, you have a black-and-white print. It's made by the Camera Corp. of America and will sell for about $20.

Among other interesting cameras introduced at IPEX:

- The Fotochrome, a simple, seemingly foolproof camera that takes pictures directly on paper—there is no negative. Its makers claim that a color print with their camera costs about what a standard black-and-white print would cost with other cameras—somewhere under 20 cents.
- The Camra-Corder, an 8mm movie camera and sound system that makes "lip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sync" possible. A special tape recorder is plugged into the camera so that sound and film are synchronized. You send the tape and film away together, and get back the developed film with a magnetic sound stripe on it, precisely synchronized with the picture. The combination, camera and recorder, will sell for about $330.

- The Fujica Mini, claimed to be the smallest and lightest camera in the world using 35mm film. It is actually a half-frame camera, yielding twice as many pictures per cartridge as a standard 35mm camera. It weighs 11 ounces, is smaller than a pack of cigarettes, and will sell for about $50.
- The Canon Pellix, a 35mm SLR with a *stationary* mirror. Other SLRs have the problem of getting the mirror out of the way while the picture is being taken. The Pellix mirror never moves. The secret: The mirror coating is so thin that light can pass through it. Some light is lost, but Bell & Howell claims the amount is insignificant. Cost: about $320.

New meters. Designers have been busy in many areas besides cameras. Three new meters at IPEX are worth mention:

- The Sekonic L-164, a CdS meter made for use underwater (down to 300 feet). It will sell for about $100.
- The Honeywell 1/21, a spot meter that reads the light intensity of a one-degree angle of view within a 21-degree field. Cost: about $130.
- The Sinarsix, a meter that takes a reading off the ground glass of a view camera. It is a parallel development, for big cameras, of the behind-the-lens meters on 35mm SLRs. Cost: $228 for a four-by-five model.

Finally, two unusual items that caught this reporter's attention:

- The Olympus Pen Projector II, a compact machine that weighs about two pounds. It comes in a zippered carrying case for easy portability. What makes this projector unique is its separate blower unit, which supports, and plugs into, the projector. The blower also has a carrying case. Cost: projector, about $40; blower, $10—both with case.
- The Argus electromatic slide viewer, which takes a stack of 36 35mm slides and automatically passes them under the magnifying lens at five-second intervals (you can hold the slides for longer viewing if you wish). Cost: about $20. ■ ■

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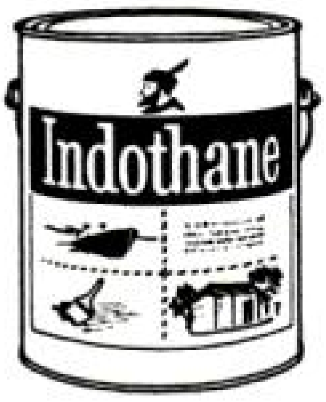

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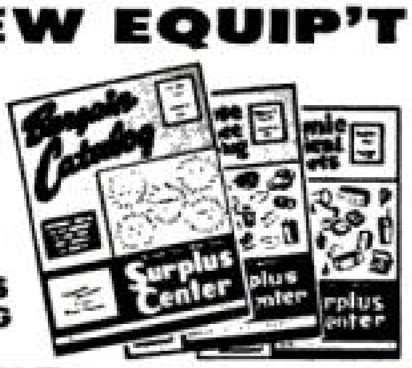

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A Rendezvous in Space

[Continued from page 59]

first. After Atlas burnout, the Agena D will be fired up and injected into a circular orbit 160 miles high, inclined 28.87 degrees to the plane of the equator.

About 100 minutes later, on the first orbital pass of the Agena over the Cape area, the two-stage Titan II launch vehicle must inject the Gemini spacecraft into an elliptical orbit inside the Agena's circular one. This elliptical orbit is to have a perigee, or lowest altitude, of 87 miles; and an apogee, or highest altitude, of 140 miles. (All distances, thus far and subsequently, are in nautical miles; the corresponding figures in ordinary statute miles would be about 15 percent larger.)

It is very important that the Agena's and Gemini's orbits be nearly "co-planar" —in the same plane, like two figures drawn on the same sheet of paper. The permissible inclination between the two orbital planes is approximately half a degree.

To attain such accuracy is quite a trick. During the 100 minutes that elapse between the launches of target vehicle and spacecraft, the earth's spinning will turn the Cape Kennedy launch site 25 degrees toward the east—while the Agena's orbit remains fixed in space. This problem of the earth's rotation can be minimized by selecting an orbital plane whose northernmost point nearly coincides with the latitude of the Cape. Nevertheless it is still necessary to actively steer and change the azimuth heading of the Titan II booster, during its powered-flight phase, to make the planes of the two orbits coincide.

The period of revolution of the Gemini spacecraft around the earth, along its inner elliptical orbit, is about 1½ minutes shorter than that of the Agena target. This difference gives the Gemini—the "chaser" vehicle—a 5½-degree-per-orbit "catch-up" rate on the target.

The spacecraft's launching is so planned that the Gemini will be about 20 miles behind and 20 miles below the Agena after 3½ orbits (when it has swung out to its apogee for the third time, about six hours after launch). In this relative position, the Gemini now turns on its spacecraft propulsion and "circularizes" its hitherto elliptical orbit, at 140-mile altitude.

Rendezvous maneuver begins. The Gemini astronauts start their actual closing-in maneuver from this circular 140-mile-high

orbit. The Agena target vehicle is space-stabilized by an attitude-control system employing gyroscopes and little thrusters. It displays a flashing light, easily detected against the star background.

The Gemini's pilot has two control sticks, one in each hand. They activate little thrusters—midget rocket engines of 25 to 100 pounds' thrust apiece. In air-less space, these provide the vital control forces that an airplane gets by deflecting its aerodynamic control surfaces.

By moving one of the sticks, the Gemini pilot can point the nose of the spacecraft up or down, and turn it left or right. With the other stick he can move the entire craft up or down, shift it sideways, or push it forward or backward.

Using this manual control, the Gemini pilot brings his spacecraft closer to the target, which all the time is flashing its light in the sky ahead of him and above him. By preventing the flashing light from drifting up, down, or sideways with respect to the star field, he keeps his own craft on a "collision" course with the target.

The Gemini's on-board radar keeps him informed of the remaining distance to the Agena, and the closing rate (relative approach speed). As the distance diminishes, the Gemini's excess speed is reduced.

About 20 minutes or so after initiation of the closing-in maneuver, the two vehicles will be within a quarter of a mile of each other, and the relative velocity will have been reduced to eight or 10 feet a second (about 5½ to seven m.p.h.). From this position the final docking phase begins.

Docking. Windows in the spacecraft provide ample vision to perform the docking manually. The Agena target vehicle is equipped with a "docking collar" designed to absorb shock loads produced by a collision velocity up to 1½ feet a second (about one m.p.h.). The docking mechanism includes a latch that prevents the Gemini spacecraft, on making contact with the target Agena, from breaking loose again.

Once the two vehicles are coupled, the pilot of the Gemini can maneuver the combination as if it were a single spacecraft.

To conclude their mission, the Gemini astronauts will uncouple their spacecraft from the target Agena. Then, using its thrusters, the Gemini spacecraft will back away—and, like earlier Geminis, will return to earth by itself. ■ ■

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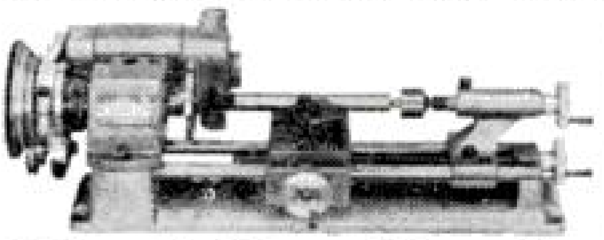

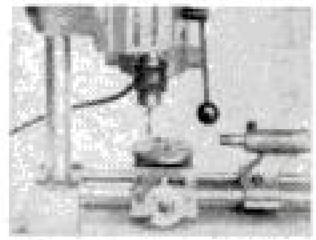

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Our One-Package Landing Force
[*Continued from page 43*]

the problems that dogged World War II amphibious operations are considered. Much time and effort had to be devoted to planning, preparation, and training to make certain that enough ships of the right types were brought together at the right time and place. If ships were lost to enemy action or disabled by storms or accidents, the whole striking force was unbalanced by the loss of a necessary type of cargo.

In addition to greatly simplifying logistic planning, the "one-package" concept makes possible the tactics needed to deal with limited wars where speed and mobility count above all else. LPD striking forces can take advantage of fleeting opportunities and maximize the surprise element. A fleet of ships like the Raleigh permits the dispersed application of force when desirable, since each is fully capable of an independent, fully integrated effort.

Designing an LPD. How do you go about combining the characteristics of four types of ships inside a single hull? The first problem was the all-important launching dock, or well deck, along with the necessary ballast tanks to sink the ships's stern enough to give the landing craft free passage. The decks had to be capable of handling such weights as 48-ton tanks. Ramps were needed so the vehicles could move from storage onto the landing craft. Facilities had to be provided for berthing and messing almost 1,500 men. Galleys and refrigeration were necessary, as were such items as cargo stowage, secure ammunition spaces, elevators, and a hundred-and-one other things to make the one-package plan workable.

Most important, however, the new LPD had to be capable of loading men and machines *quickly* while under enemy fire.

The final form taken by the Raleigh is that of a completely mechanized warship with a displacement of 13,900 tons (fully loaded), a length of 522 feet from bow to stern, a beam of 84 feet, and measuring 54 feet from main deck to keel. Two turbine engines, each rated at 12,000 horsepower, propel the vessel at a sustained sea speed of 22 knots.

Because of the internal mechanization of the LPD, vehicles, men, and other cargo can be moved by elevators and loaded into landing craft or picked up by helicopter three or four times faster than has ever before been possible. Consequently, troops

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and weapons move rapidly toward shore—important both from the standpoint of striking fast and by surprise, and because the LPDs are not kept hanging around offshore offering attractive targets for enemy submarines and aircraft.

Not that the LPDs are incapable of defending themselves—the Raleigh carries a battery of eight fast-firing three-inch guns with which she can provide covering fire for landing forces, or defend herself against air attack.

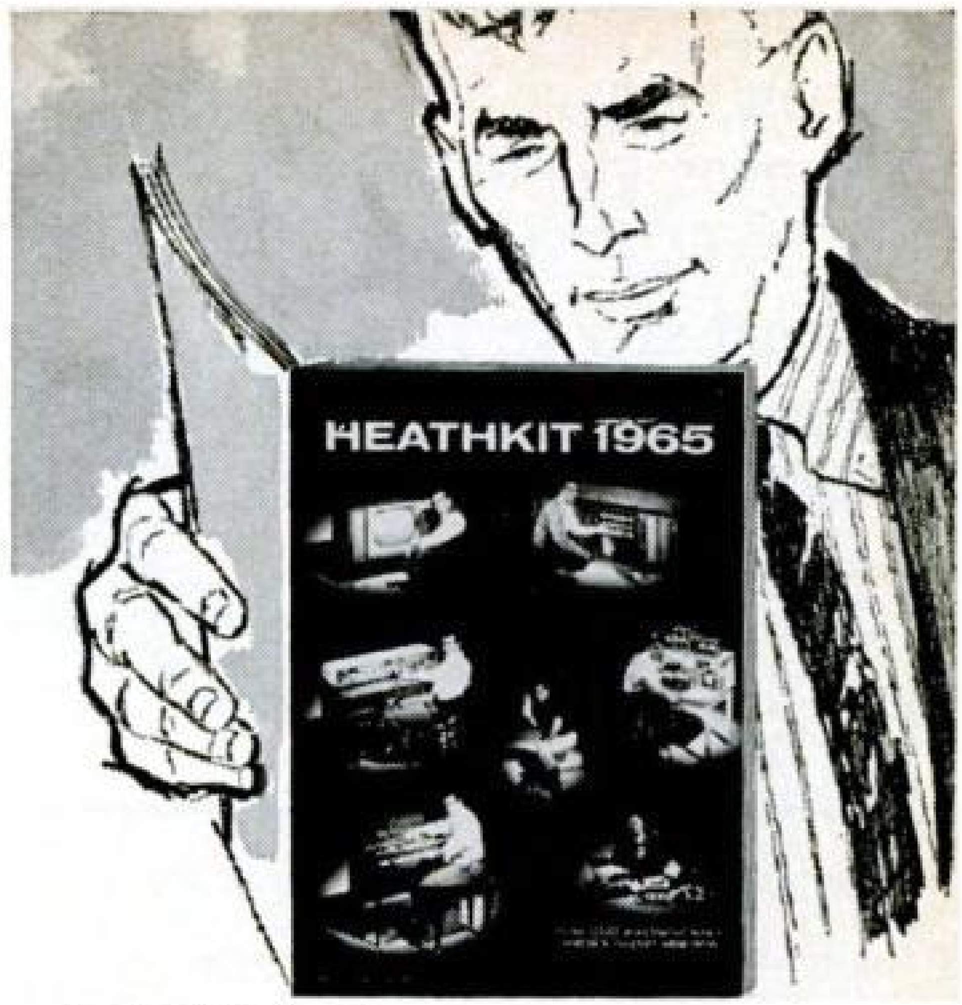
Coming: more LPDs. Two sister LPDs have already joined the Raleigh on active duty: the Vancouver, now deployed with the Seventh Fleet in the South China Sea, and the La Salle, with the Sixth Fleet in the Mediterranean. Thirteen of these ships are now completed, under construction, or under contract. Of these, four were commissioned in February, two more will be added to the fleet later this year, another four in 1966, the others in 1967.

To add even more self-sustaining features to the LPDs, some of the later ships will be increased in length with a 48-foot hull section added amidships. The enlarged ships will have even more cargo capacity, plus facilities for helicopter maintenance. The Austin (LPD-4) and Ogden (LPD-5) will be enlarged LPDs.

With the development by the Navy and Marine Corps of "vertical-envelopment" tactics—the use of helicopters for part of the ship-to-shore movement of troops, and for striking at enemy rear areas and supply lines—yet another amphibious ship has come into being: the LPH (helicopter landing platform).

The LPH has a flight deck and ample repair and maintenance facilities to operate 24 helicopters. She can also carry a sizable number of troops, but cannot accommodate landing craft or large numbers of heavy vehicles. The Navy feels the ideal amphibious squadron might include three or four LPDs with one LPH—a thoroughly flexible air-sea-land combination capable of landing and supporting an entire Marine regiment of 5,000 men or more.

Non-nuclear fighting forces to meet small, localized conflicts the world over seem likely to be the most needed type of military power in the years ahead. With the Raleigh, the Navy can put those fighting men into action at the right place and the right time to do a job. ■ ■



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Improving Your Home Wiring

[*Continued from page 145*]

(same as a switch box) should have only four—two wires in the cable leading in, two in the out cable. Junction boxes, like those in unfinished basements and attics, being larger, can accommodate more wires. (For the full listing of box sizes and the number of wires permitted in them, ask your electrical supplier for a copy of the National Electrical Code, and see Article 370, Section 6.) For most outlet-adding jobs the box wiring shown in the drawings will apply.

Receptacles. When used in new outlets receptacles must be the grounding type, though the older forms are okay for replacement of existing units.

If the cable leading to your existing (starting) receptacle doesn't contain a grounding wire, the box itself may not provide a safe ground for your wiring extension. Check it with a pigtail-type insulated bulb socket with an incandescent bulb in it. Attach one of the socket wires to the black wire (at the brass terminal), the other to the box itself. If the bulb lights with the switch on, your ground is okay. If not, check with your local inspector on the locally approved grounding method.

If for some reason you can't remove the starting box, you'll have to remove a knockout from the bottom with the box in place. If the knockout is slotted, use a screwdriver to pry it up and break it free. Otherwise tap the screwdriver against it with a hammer to break it out downward. The freed disk will drop inside the wall.

Getting the cable to the box. For an outlet on the first floor (above a basement), bore a ⅜" hole up into the base of the wall directly under the box. Then form a ½" hook on the end of a piece of stiff wire and push it up through the hole. If you have a helper, have him lower a similar hooked wire through the hole in the box, and swing it around until it links hooks with the upcoming wire. (If you haven't a helper, wedge the lower wire, then hook it from above.) Pull the end of the wire up into the box and secure it. Form a small hook on the other end, bend the bared ends of the cable wires over it, and tape them lightly in place. Now you can pull wires and cable into the box for clamping. If the box lacks built-in clamps, your hole from the basement must pass a cable connector.

Cutting the wall for the box. At the new

outlet location use a tracing of the template illustrated to outline the wall opening for the box. Bore the holes with a masonry bit if you have one, as plaster or gypsum board dulls wood bits quickly.

Use a pistol-grip hacksaw to make the straight cuts. In a wood-lath and plaster wall, don't cut through two laths. Move the box opening up or down so that you cut through one, part way through those above and below.

Bore a ⅝" hole up into the base of the wall as before, and simply push the cable up far enough to reach it through the box opening and pull it out. You can open the knockout and pull the wires into the box before inserting it in the opening. Don't tighten the cable connector until the box is in. You'll need flexibility to get it in.

Mounting is simple. You can use an "old work" box with built-on clamps that lock behind the wall surface when screw-tightened from the front, or slip in bend-over sheet-metal clamps on each side of the box, as shown in a drawing. The brackets at the box ends should be set flush with the wall surface when the clamps tighten.

Making the connections. Wire-to-terminal-screw connections always follow the same rule: black wires to brass terminals, white wires to chrome terminals. (Easy way to remember: white wire to white metal.) Wire-to-wire connections, as in a junction box, are always black to black, white to white. (There's an exception to this in switch wiring, but it doesn't apply in simple outlet wiring.) The green-sprayed grounding terminal on your receptacle is connected only to the box itself.

In all wire-to-wire connections use wire nuts (solderless connectors) to assure a solid contact without soldering. Bare just enough of each wire to fit all the way into the connector. Twist the wires together lightly and screw on the connector. The cap is insulated; no taping is needed.

Mounting the receptacle. After the wires are connected to the receptacle, bend them so they'll flex easily when you push the receptacle into the box. Remove the fiber washer from the screws in the receptacle ears and turn the screws into the threaded holes centered at the box ends. There's a threaded hole in the center of the receptacle to take the screw that holds the cover plate. Put the cover plate on, switch on the juice, and your new outlet is in business. ■ ■

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[Continued from page 49]

popularly, if erroneously, known as the sound barrier.

This pressure wave, like a big hand trying to hold back the speeding object, consists of molecules of air. The molecules don't all travel at the same speed around the object. Last fall, for example, while I felt nothing strange in my cockpit, I was told that local air speeds, notably those over the cockpit canopy, evidently were transonic. Ed said that at the peak of my racer's speed it sounded like a .22 rifle being fired. A projection of any kind causes the air to speed up locally.

Bear that shock wave in mind for a moment.

We have figured out that at Mach 1, the speed of sound, every square foot of the front of the next version of the Green Monster will be subjected to 1,500 pounds of air pressure. Last fall, even though I had built my racer to withstand 800 pounds, we got some cracks in the aluminum skin.

I can beef up the structure under the skin, which is 63/1,000 of an inch thick. Getting the skin to stand up doesn't bother me. What does bother me is the generation and travel of the shock wave.

Unfreezing control. Years ago a phenomenon called a "reversal of control" occurred when airplanes first began getting into transonic speeds. The major (unlocalized) shock wave moved aft from the horizontal stabilizer in the tail group on to the elevators and "froze" them. Pilots discovered a trick—if they pushed forward on the control stick for up elevator, instead of down, it would unfreeze the control. That fault has long since been designed out of supersonic planes by moving the shock wave aft.

Now, let's consider that in the design of my next Green Monster. Last fall I discovered that when I shut down my engine after going through the measured mile, the combustion air would build up in the cup formed by the engine cowling ahead of the engine's compressor section. It had to—it wasn't going on through the engine any more.

But then the air spilled out of the cup, carrying lubricating oil with it. The oil's path—on to my stabilizing wing and on across the engine skin clear back to the fin—showed where the spilled air went. It hammered at my racer far forward of the center of gravity.

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How I'll Drive Faster Than Sound

If I got the same thing in the form of a shock wave on a supersonic run, with the air spilling out and following a similar path to the stern, the pressure patterns could make the car swap ends at a given speed in a fraction of a second.

The answer, of course, is to engineer the center of pressure—the shock wave—to a point behind the center of gravity. And how am I going to do that except by taking in combustion air toward the stern of the engine and piping it forward? I don't want to do this—the air would have to make two 180-degree turns to reach the compressor section up front. That not only would heat it up but disturb the air flow as well. The hotter and more turbulent the air at the combustion stage, the greater the power loss.

Why not solid fuel? There is an alternative. That's to use a solid-fuel rocket engine instead of a gas turbine. Rockets, like the Polaris and Minuteman in our defense arsenal, need no air. They incorporate their own oxidants.

But solid-fuel rockets as yet can't be shut down and restarted, and until they can, Bonneville's safety rules ban them from the course.

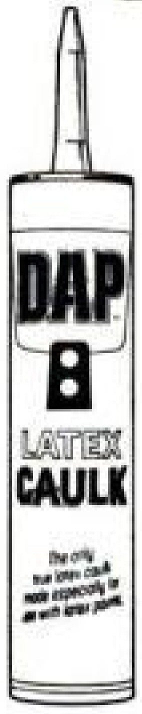
So I have to compromise on a gas turbine, and my present thinking is explained in an accompanying illustration. One aerodynamicist who looked over the Green Monster of 1964 when it was on display at the New York automobile show last spring told me that at supersonic speed the shock wave would be unstable and cause vibration—the wave would "walk" back and forth on the canopies enclosing the matching cockpits on each side of the machine.

But that's on the existing Monster. I'm confident that we can design out that kind of vibration. Moreover, I've got an idea about the air spilling out the front of the cowl. I can reduce the volume of it by reducing the area of the cup with a big center cone. Sure, the engine will partly starve for air until I reach perhaps 300 m.p.h., but then ram effect will give it enough for proper combustion.

Some old ideas. On the supersonic vehicle, I will use many of the ideas I used before. I will scoop air from under the car for added tailpipe volume aft of the burners. That creates a low-pressure area underneath and boosts my stability at the

CONTINUED

WON'T STAIN



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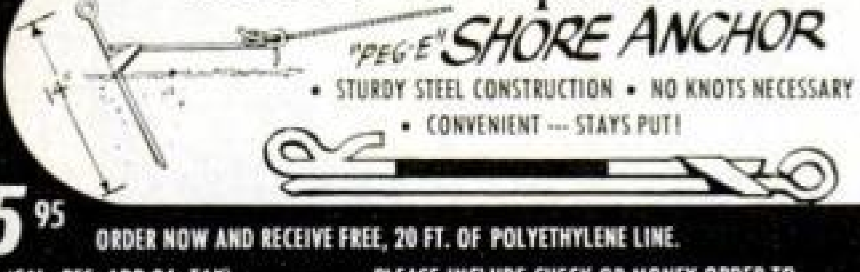

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wheels. I will use my wing. I will use a throttle stop on my foot accelerator to insure a precise power output for each run. I can change this stop with a switch on the dash. I will build in fail-safe devices—if a compressor section fails, for example, all my machinery—parachutes and brakes excepted—will shut down automatically.

I will not use a rudder. Last fall's runs proved I didn't need the one we had. We bolted it into neutral.

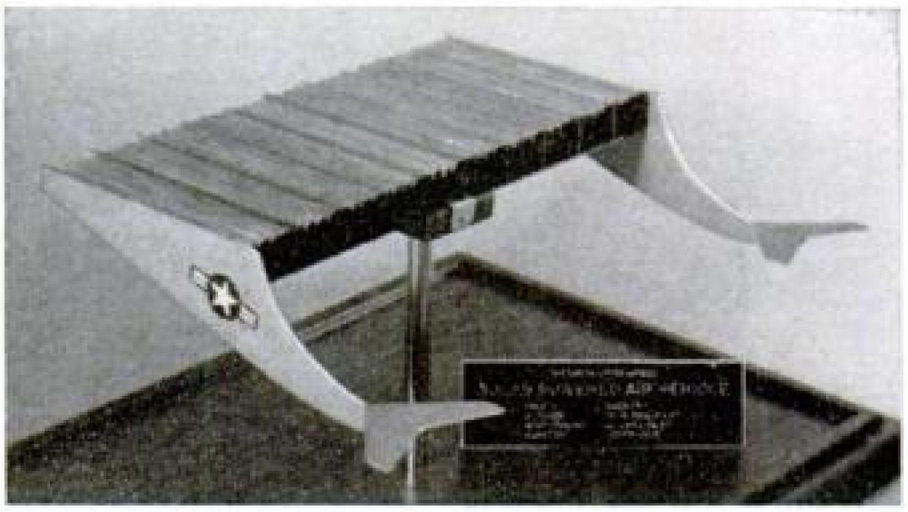
Other men, including Breedlove, are going back to Bonneville with the same idea I've got, but none of us will be ready before a year from this fall.

I hope I won't have to run there. The smooth salt, providing room to accelerate, whiz through the measured mile, and decelerate, only extends for 10 miles. Decelerating from supersonic speed in 4½ miles just might not be possible. The Firestone people and I are thinking about the dry lake beds in Argentina and Chile.

Racing on "the salt," as we call it, is a funny thing. A man doesn't feel that he's competing against other men. He's competing against the salt, against nature. I don't like Bonneville. When I'm there I can't wait to get away. But once I'm away, I can't wait to get back. Bonneville is like a woman you keep quarreling with but can't stay away from.

That's one reason I'll be back there this fall with my present Green Monster as a preliminary to my assault on the speed of sound there or somewhere else. ■■

Solar-powered flying wing



Sun rays would be the fuel for the aircraft shown above in the model. Elmer G. Johnson, chief of the fluid-dynamics facility at Wright-Patterson Air Force Base, foresees application of his invention as an unmanned, instrumented vehicle for research or reconnaissance, flying at high speeds up to 60 miles above the earth.

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[Continued from page 81]

loaded to take others aboard, suit the procedure to the circumstances. If there's no urgency and the shore is nearby, drop your passengers at the nearest landing point and return for the others. If those in the water are exhausted, swimmers among your passengers may go overboard to make room, and stay with the swamped boat while you ferry the others ashore. If the spilled sailors are in good condition but darkness or threatening weather makes the situation urgent, you can tow swimmers ashore holding to a line behind your boat. Keep your speed around five miles an hour.

- If you have to leave people behind for an extended time, take a sight on shore landmarks that line up with the wind direction. This establishes the drift path and makes the boat easier to locate when help arrives. Call the Coast Guard first in areas it covers.
- With all hands accounted for, look at the boat. It's usually simpler than it looks to right a small boat. If the outboard motor is light enough, lift it off and into your boat. As shown in a photo sequence, the swamped boat can often be placed aboard the rescue craft to empty it.
- The "power shake-out" frequently works on boats with motors too heavy to remove, with motor weight keeping the low cut of the transom submerged. Fasten a towline from the bow of the swamped boat (right side up) to firm cleats in the stern of yours. Ease forward to take up the slack gradually, then open your throttle for quick acceleration. Inertia sends the water in the swamped hull aft over the transom. Temporarily free of water, the bow rises. Throttle back slowly; the bow will settle as the remaining water surges forward. Before it digs in or the towline slackens, speed up again and repeat the process. Finally, bail out the remainder.
- If a boat is sinking, as can happen with some ballast-keel jobs and old-timers, there's always a chance it can be raised later. Once all hands are clear, the sinking boat's best friend is a long line, even a fishing line. Tie it on wherever you can, and let it reel out as she goes under. When the line stops moving, tie a float on it. It will guide the skin diver from the salvage barge. If she's still going down when the end of your fishing reel pays out, forget it. You can always buy another fishing line. ■ ■

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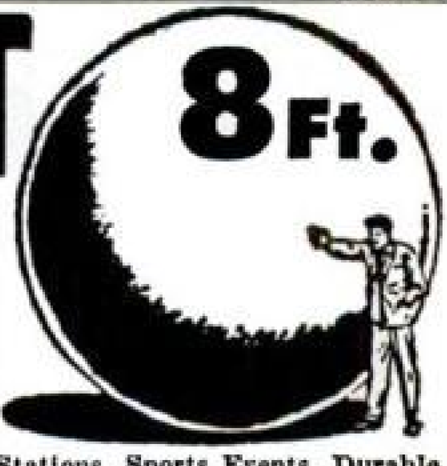

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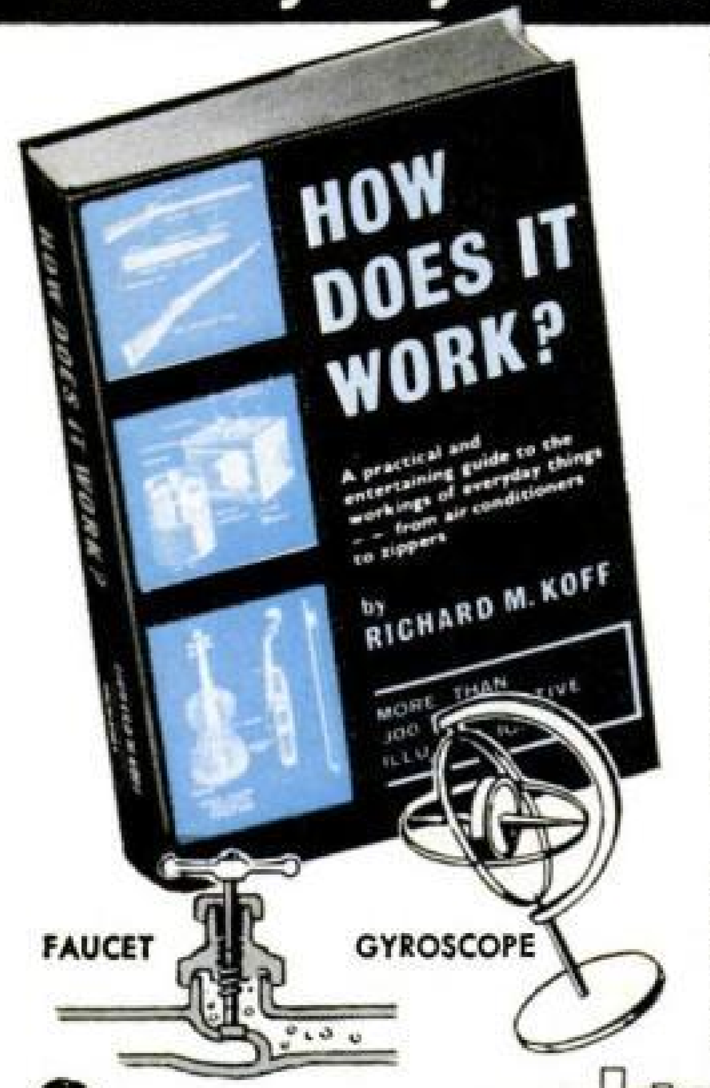

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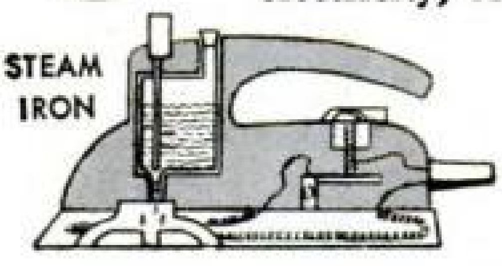

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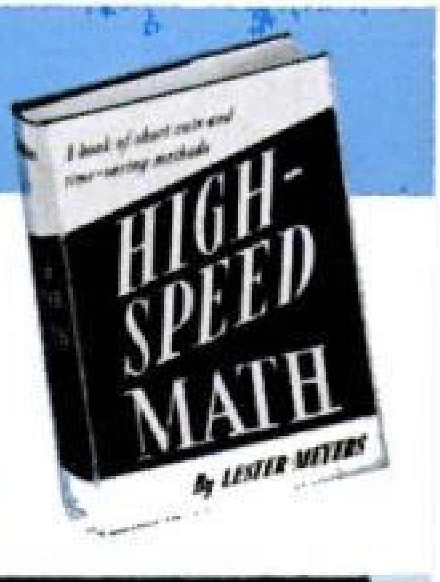

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How to Tackle Torque
[Continued from page 78]

Blade pitch is such that the prop must swing in a clockwise direction to move the boat forward. This type of propeller is a "right-hand" wheel, by far the most common.

Now imagine that right-hand wheel turning, as if the boat were in the water and moving forward. The blades move *downward* on the boat's right-hand side, swing *up* on the left of the centerline. Despite the angle, or pitch, of the blades there is enough *horizontal* resistance to push water downward on the right, lift it on the left. Combine a powerful engine with a light hull and you see how the right side of a boat can be lifted, the left lowered.

A rotating propeller can also produce unequal thrust, which varies with its tilt angle, as shown in one illustration.

Taming list. Here's how you can solve the problems of list created by torque:

1) Match the power to the hull.

2) Watch the trim. Proper loading of light hulls cures list.

3) Use trim tabs. They can be adjusted to lift the port side, counteract list.

Correcting steering problems. This is a bit harder. In some cases, the skipper must *use* torque, rather than fight it:

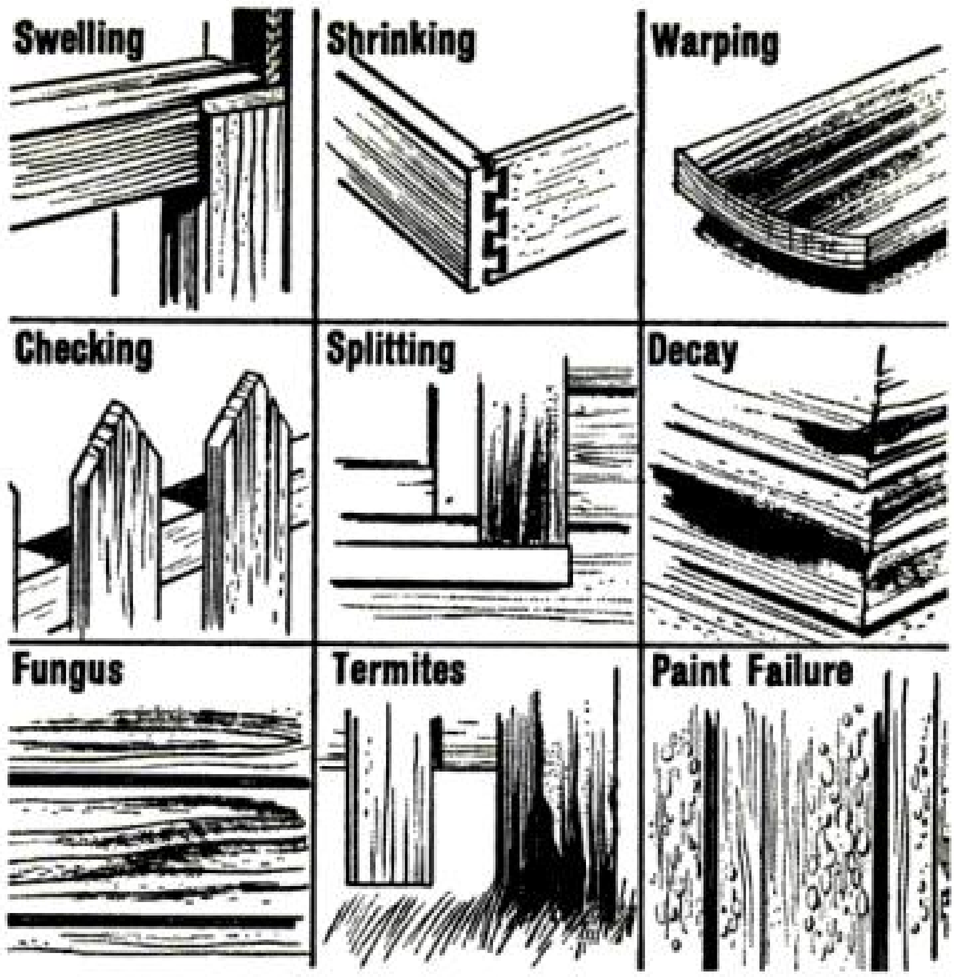
1) Watch the prop angle. Avoid tilting outboard or stern-drive lower units in or out to solve a trim problem; shift load instead to achieve proper planing angle.

2) Use tabs again. Like trim tabs on aircraft control surfaces, tabs on rudders of small power boats offset torque.

3) If you can't defeat torque, make it work for you: Remember—a single-engine inboard with a right-hand prop tends to steer toward port going ahead or backing. It's no real problem when going ahead, but can be troublesome in reverse. She'll turn to port easily enough, but won't back down to starboard unless you use more power than may be advisable.

Avoid backing to starboard when maneuvering or turning around near dock areas and in tight channels. To turn around, come in on the side of the channel where you swing to starboard first. Let the way come off the boat, then go into reverse and back down to port; turn the wheel to starboard again when you go ahead once more. Since you aren't battling torque, you can turn in an unbelievably tight space.

Master this trick and you've got torque aboard—as a member of the crew. ■ ■



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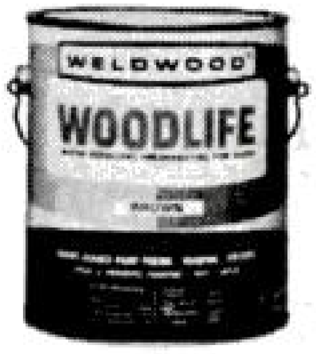

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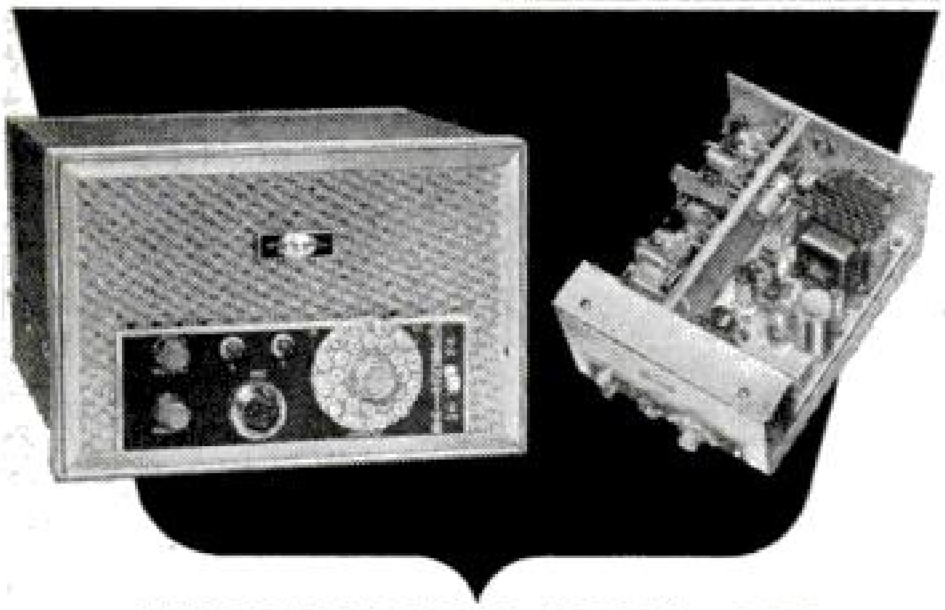

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SEE THE USA

New Engine for Space Does Down-to-Earth Jobs

[Continued from page 105]

Better than air. Air isn't the best working medium. Hydrogen is 50 percent more efficient at high speeds. Next best is helium. High-efficiency Stirling engines will use one of these gases. But air delivers more torque at low speeds (up to 1,200 r.p.m.) and may serve for big engines.

Cooling is a problem—a Stirling engine must reject more heat than an internal-combustion engine. A Stirling car engine would need a radiator 2½ times as big as a gasoline engine of like horsepower.

Because it could deliver high torque even at low speeds, a Stirling-powered car might not need a transmission. But engine speed would have to be controlled by changing the amount of working medium in the cylinders, requiring tanks and a pump.

In space or on the moon (with no air to carry off heat), the only solution will be to radiate heat into space. For the three-horsepower satellite engine of GM's Allison Division, this would require a radiator with over 200 square feet of surface.

Big babies. Small Stirling engines for lawn mowers or riding tractors would be bulkier, though more efficient, than their gasoline counterparts. And costlier.

Unlike a gas engine, the Stirling could be run safely indoors with ordinary ventilation: A properly adjusted burner would produce no carbon monoxide. Starting is so reliable that the latest ground-power units being sent the Army for testing dispense with the electric starter earlier ones had.

Multicylinder Stirlings, experts say, will be no heavier than the best diesels—but quiet, smooth, with monoxide-free exhaust, and an appetite for cheaper fuels. They've already been built in sizes up to several hundred horsepower.

With the whole ocean as a heat sink for cooling, Stirling marine engines are a natural. They would make engine rooms much quieter than diesel-powered ones.

A more dramatic seagoing application is the Stirling torpedo engine blueprinted by GM. It would be fueled by hydrogen peroxide and diesel oil. The four-cylinder opposed-piston design, occupying 11.6 cubic feet, would develop 578 horsepower—almost 50 horses per cubic foot.

In nuclear submarines, Stirling engines fueled by heat from the pile would be more efficient than steam turbines. Non-nuclear subs could be driven by oil-burning

Stirling engines, whose low noise level would make them less detectable than diesels during surface runs.

Heat misers. Thermal-energy storage is the term for the ability of certain materials to hold a great amount of heat for long periods. In the satellite engine, such a system would store sun heat to keep the generators running in earth's shadow.

Non-nuclear subs now depend on batteries and electric motors for below-surface running. A thermal-storage test unit built by GM demonstrates advantages over battery drives. Aluminum oxide in an insulated tank is heated to 2,800 degrees F. From the stored heat, a 30-horsepower Stirling engine develops 100 horsepower-hours.

A full-sized system would deliver 52,000 horsepower-hours. At medium speed, its underwater cruising range would be more than eight times that of a battery-motor drive of the same weight. It could also be recharged much more quickly, an advantage that might mean life or death in wartime.

Heat can be piped from a thermal storage tank, or from the focal point in a solar reflector or collector, by circulating gas or a chemical to the engine and back.

Prof. Farrington Daniels and Dr. Theodor Finkelstein, working at the University of Wisconsin, demonstrated an ingenious way of getting radiant heat into the displacer cylinder. They fitted it with a transparent quartz head. A heat-absorbing material on the end of the displacer transmits the heat to the working medium.

"The system is simple and efficient, holding considerable promise," Dr. Finkelstein says. "Solar engines are limited in size merely by the collector. But the most practical size for undeveloped countries is ¼ to ½ horsepower."

Israel showed a design for a solar engine in Rome in 1962. This year Prof. Erich Farber of the University of Florida described an experimental, windowless hot-air solar engine that developed ¼ horsepower.

As a final surprise, the Stirling engine is thermally reversible. Run it backwards by another engine or motor, and the heater tubes get hot. Drive it the way it would run, and the cooler tubes get warm, while frost forms on the heater tubes.

This was one of the first modern applications of the Stirling principle. Philips designed refrigerators around it, and has marketed them for years. ■ ■

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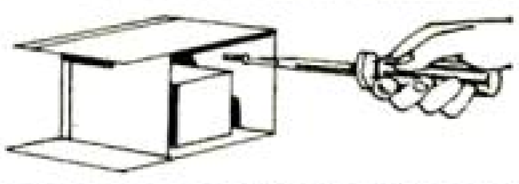

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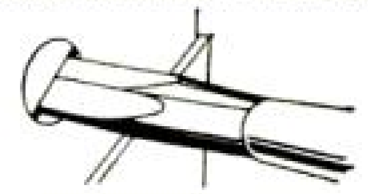

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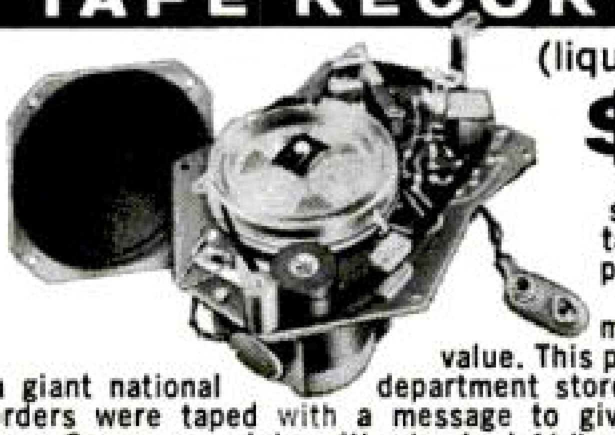

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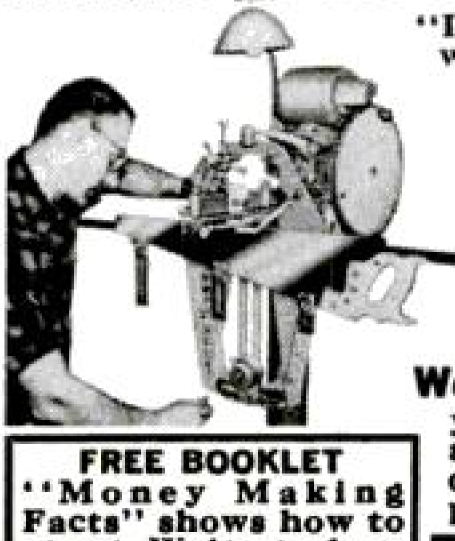

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Amazing "Space" Engine You Can Build

[Continued from page 110]

under hot water. Bubbles will rise from any leaks, which must be closed.

Cellular glass foam, sold in the form of abrasive blocks, makes a displacer that cannot leak. File teeth on a piece of cylinder stock, drill a foam block 3/32", and feed it on a rod against the rotating cutter.

To assemble the crankshaft, first drive a ball bearing up against the disk (use a piece of tubing to press against the inner race only). Insert the shaft in the housing, set the crank disk on a solid support, and press the second bearing into place, pushing against both races.

Make the power cylinder from seamless brass tubing or a 5/8" bushing. Polish the bore with abrasive cloth on a dowel. Bore the piston; then, on an arbor, turn it to a tight fit in the cylinder. Finally, hone it with a fine stone to a free but reasonably airtight fit. With one end of the cylinder held shut, the piston should resist entering, air behind it acting as a spring.

Mount the rocker on its pivot pin with the crankpin in its slot. Turn a nut onto the crankpin, screw on the crank web, and lock it concentric with the crank disk by jamming the nut against it.

Cement the power cylinder in with auto-body solder or a good metal-to-metal cement. Look through the port to see if the piston comes almost to the bottom of the recess. If not, add a washer behind the wrist-pin fork. If it hits, file a bit off the end of the fork. Put cement on the fork screw before tightening it.

Adjust the displacer rod in the rocker head so that the displacer moves full stroke without hitting the recess or the end of the cylinder. Check this while holding the cylinder in place. The displacer stroke can be varied by raising or lowering the rocker pin in its slot. Cement the cylinder in only when you're certain that the displacer action is correct. Take care not to clog the port with cement.

You should now feel compression as you turn the shaft and push the piston in. If you don't, check cylinder joints, gland, and piston head for leakage. ■■

Need more information about building or trouble-shooting the engine? Send a self-addressed stamped envelope to Stirling Engine, POPULAR SCIENCE MONTHLY, 355 Lexington Ave., NYC 10017.

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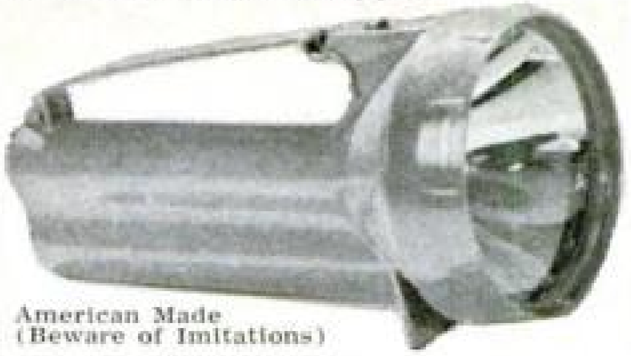

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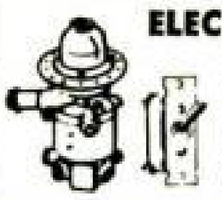

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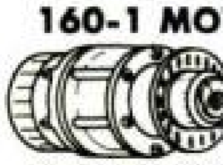

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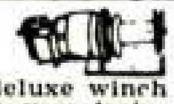

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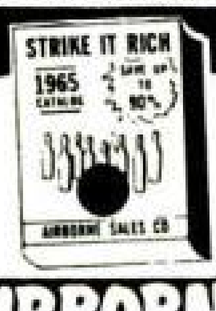

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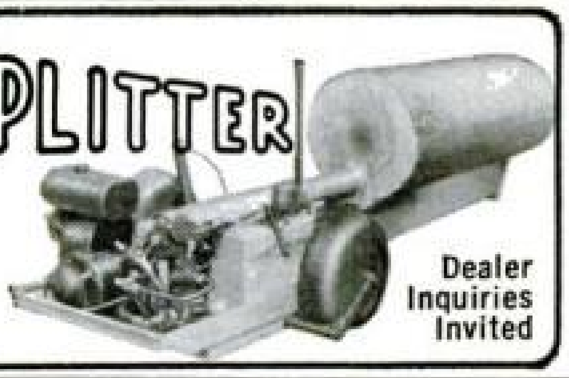

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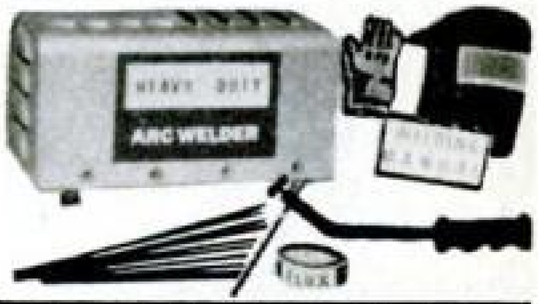

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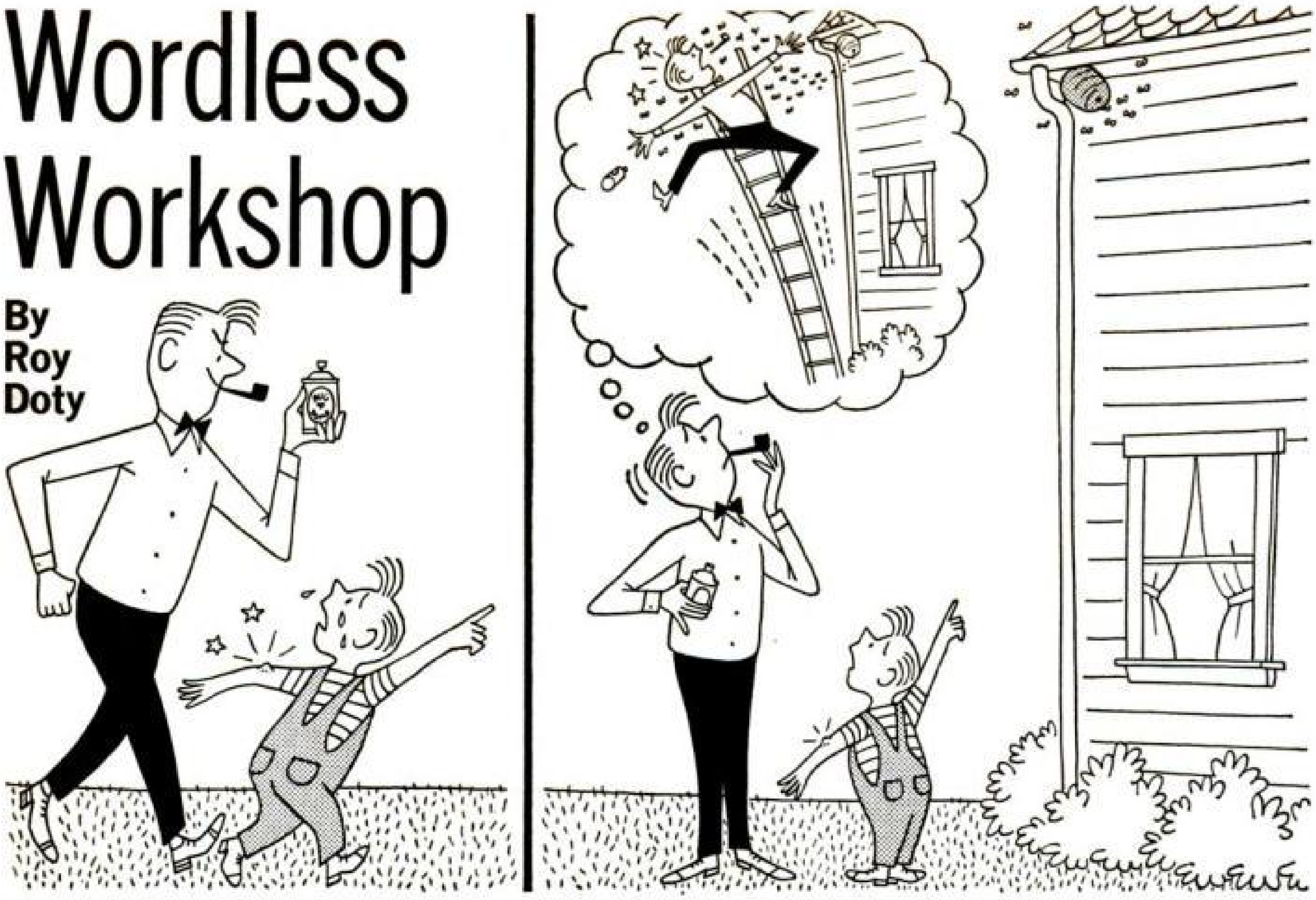

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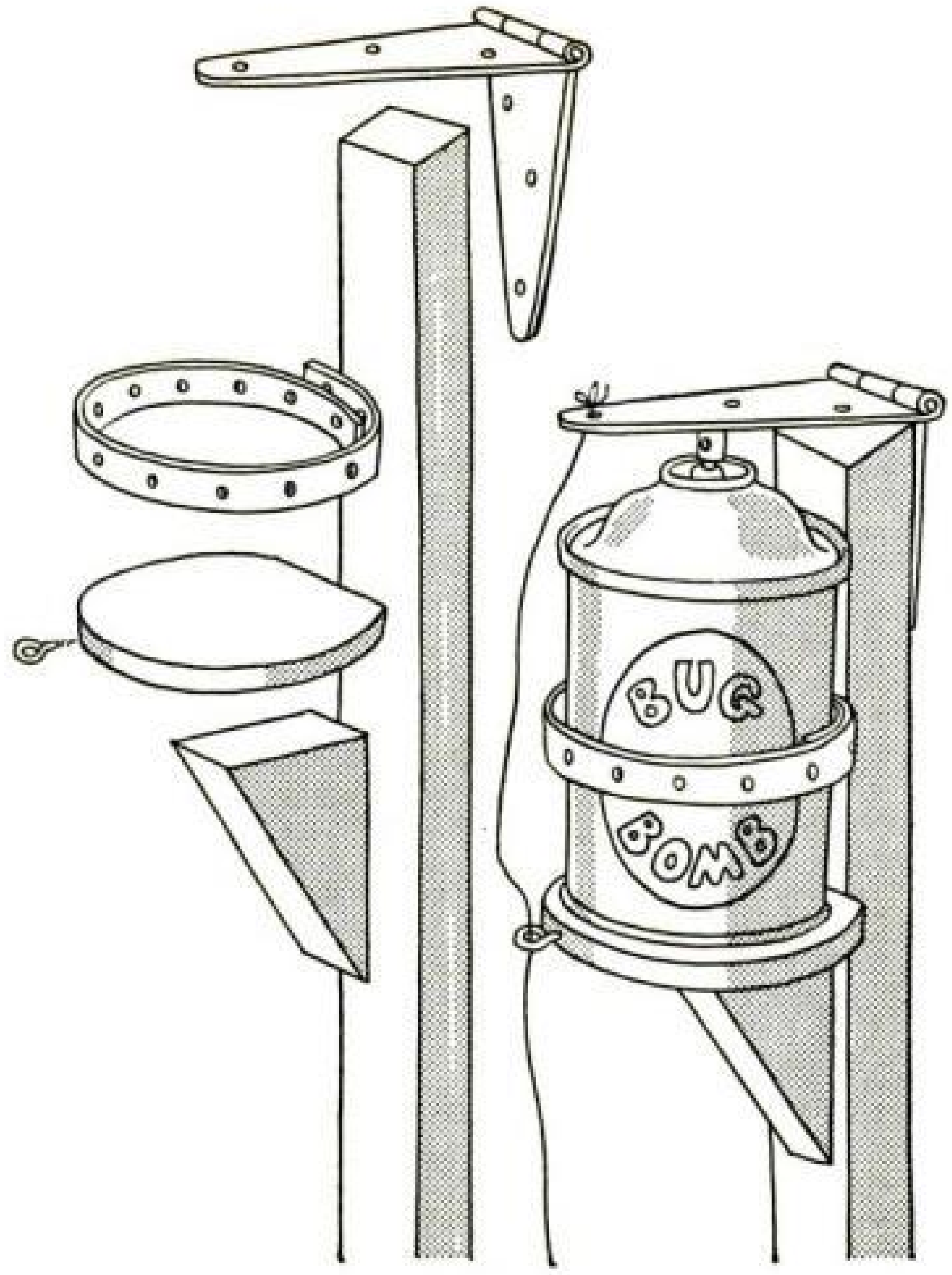

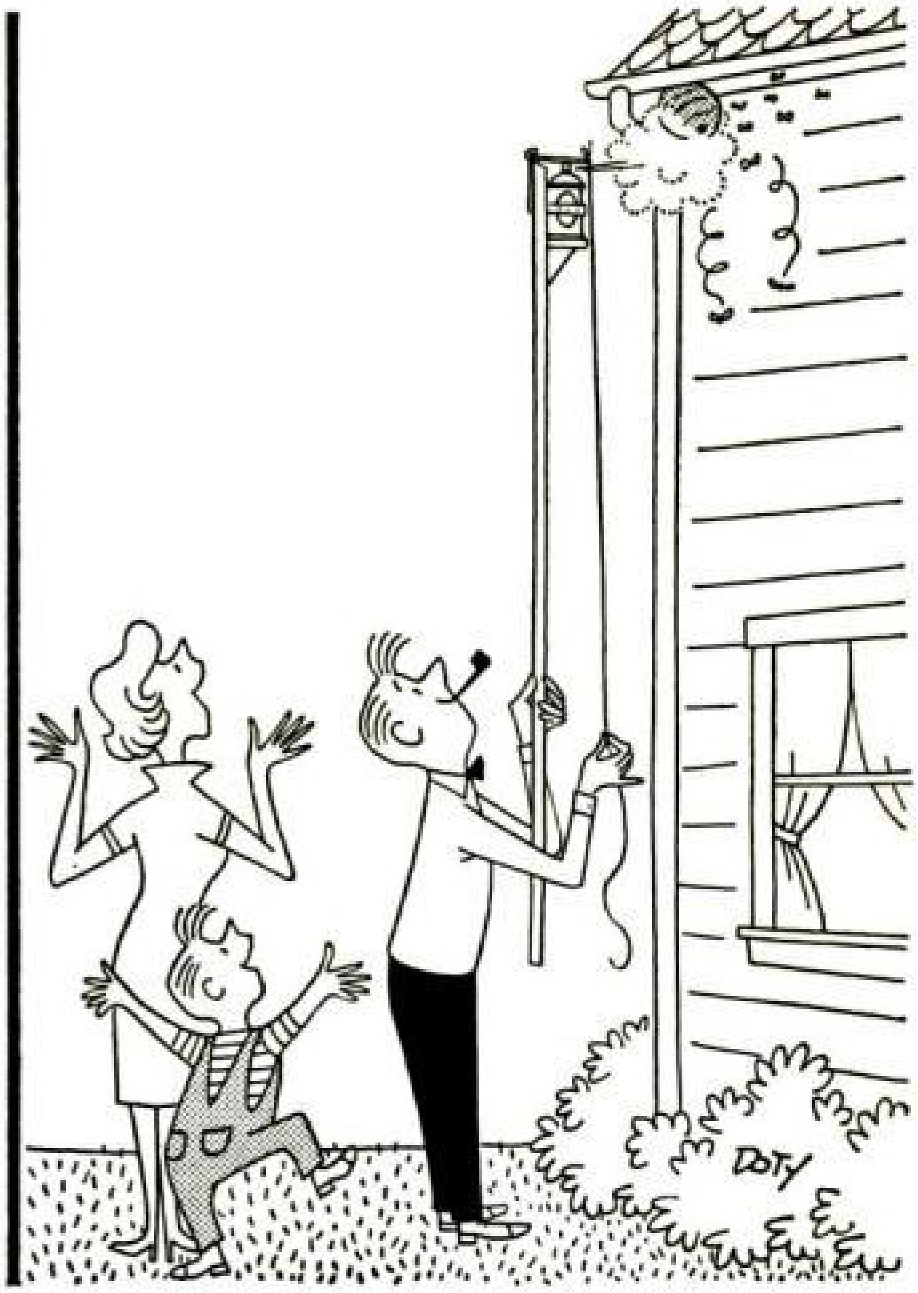

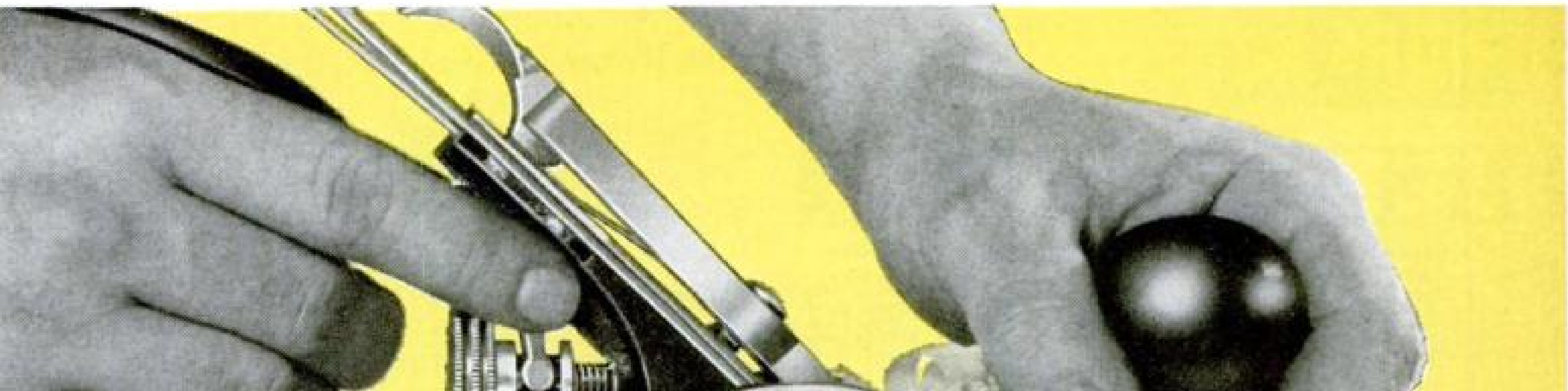

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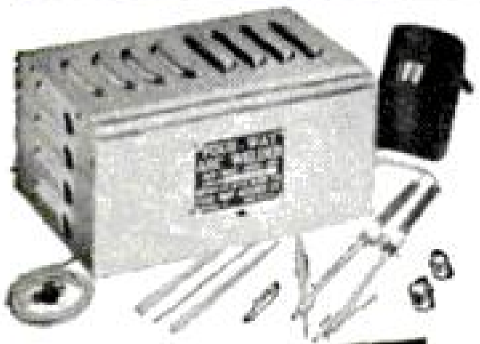

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The Day I Swallowed a Camera

[*Continued from page 57*]

to be in focus. When I press this plunger, the lenses will uncap, and the flash will ignite with an output of 50,000 candlepower. Don't worry; it's cold light. You won't get burned.

"Open your mouth and relax," the doctor said. I did, and in a jiffy, I swallowed the camera. I didn't gag, but I felt as though my neck was being throttled.

"That should be about right," said Dr. Weiss. He started squeezing air down the tube and into my stomach. "Now we'll take your portrait. Listen."

I tensed. From deep inside my belly came a far-away *pup*. What if the camera falls off, I thought—but by then Dr. Weiss had hauled the gadget back out, and I sat regaining my composure.

The camera, unopened, then was sent back to the manufacturer (Gastro-Photor Laboratories of New York City) where the film was removed and developed. Two days later I had the snapshots. No problems.

Three men and a camera. Dr. Weiss's intragastric camera is a descendant of one invented in 1927 by Dr. F. G. Back, the optics wizard who developed the zoom lens. Dr. Weiss's father, Dr. Samuel Weiss, with the mechanical help of his physician sons Jerome and Bernard, refined the camera over the years.

The big boost came with the advent of fast, dependable color film. Then Jerome Weiss substituted wide-angle plastic lenses for the original pinholes, set some lenses at an angle so that views overlap slightly, and succeeded in developing a rugged camera that in a normal stomach can make a single color exposure of 16 overlapping views, completely covering the surface area.

Besides helping in diagnosis, stomach cameras are useful in checking on healing progress after stomach operations, according to Dr. Weiss. "One would hesitate recommending X-rays on a continuing basis. The camera, of course, produces no radiation." He also plans to test the device for determining the effects of drugs on the stomach. It would show if a substance designed to, say, dry out the stomach really works.

Finally, NASA has expressed interest in the camera. What happens to food in the stomach of an astronaut when he is under half-a-dozen Gs or is weightless? Dr. Weiss's device might tell us. ■■

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[Continued from page 149]

breaks—instead of the longer, more expensive line. Such leaders are usually light monofilament.

However, if the fish you are after has unusually sharp teeth or you are working among sharp rocks, it's often best to go to a steel leader. This is not as invisible as a plastic leader, but can't be cut in two.

Long leaders are best wherever there's no problem in handling them, as in trolling or still fishing. For casting, the leader must be kept short so you can reel the lure up close to the tip of the rod. "Snelled" hooks come with their own leaders attached, in various lengths, for convenience.

The hardware. The purpose of a swivel is to keep your line from twisting even if your lure rotates in the water (most lures tend to rotate to some extent). Three-way swivels let you connect an auxiliary line to your main line, usually to support a sinker or a second hook.

Snap connectors, usually used at the end of a leader, make it easy to switch lures without having to stop to untie a knot. They can also be bought with a swivel attached to simplify certain hookups. Another type of connector has snap ends, either of which can be opened separately. This is useful for quick changing of sinkers, leaders, and other mid-line fittings.

Sinkers come in many styles and weights. The simplest is a long, slim, slotted weight that just clamps around your line. It's easy to put on, but has to be pried off. There are also similar types with connectors at the ends that hook right into the line.

There's a bell-shaped sinker with a swivel eye at the top that's handy where you want to trail a sinker at the end of a separate line instead of attaching it to your main line. Another unusual design is an egg-shaped sinker with a hole through the middle for the line to slide freely. When the fish takes the bait, the sinker stays put and the line pays out smoothly without dragging the weight.

The hardware shown here is by no means all there is, but it represents the most common types of fittings. Whenever you first try a type of fishing or location that's new to you, it's a good idea to ask local fishermen for their advice. Often they can tip you off to a piece of hardware, lure, or rigging arrangement that is perfect for that particular spot. ■ ■

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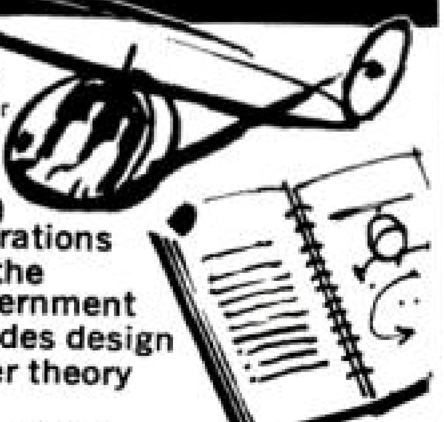

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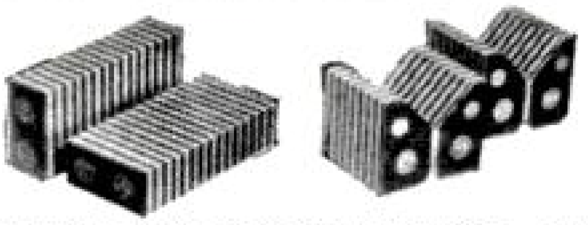

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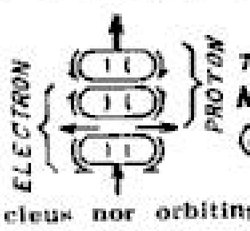

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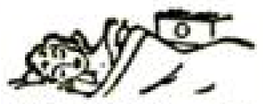

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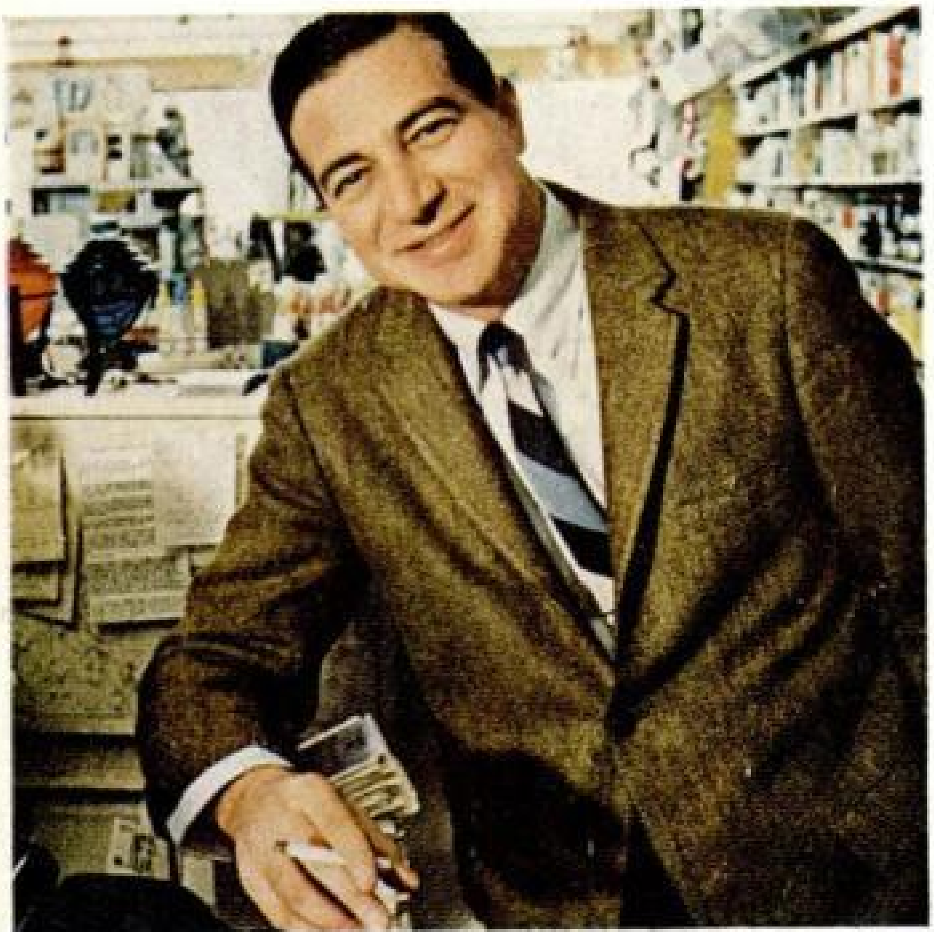

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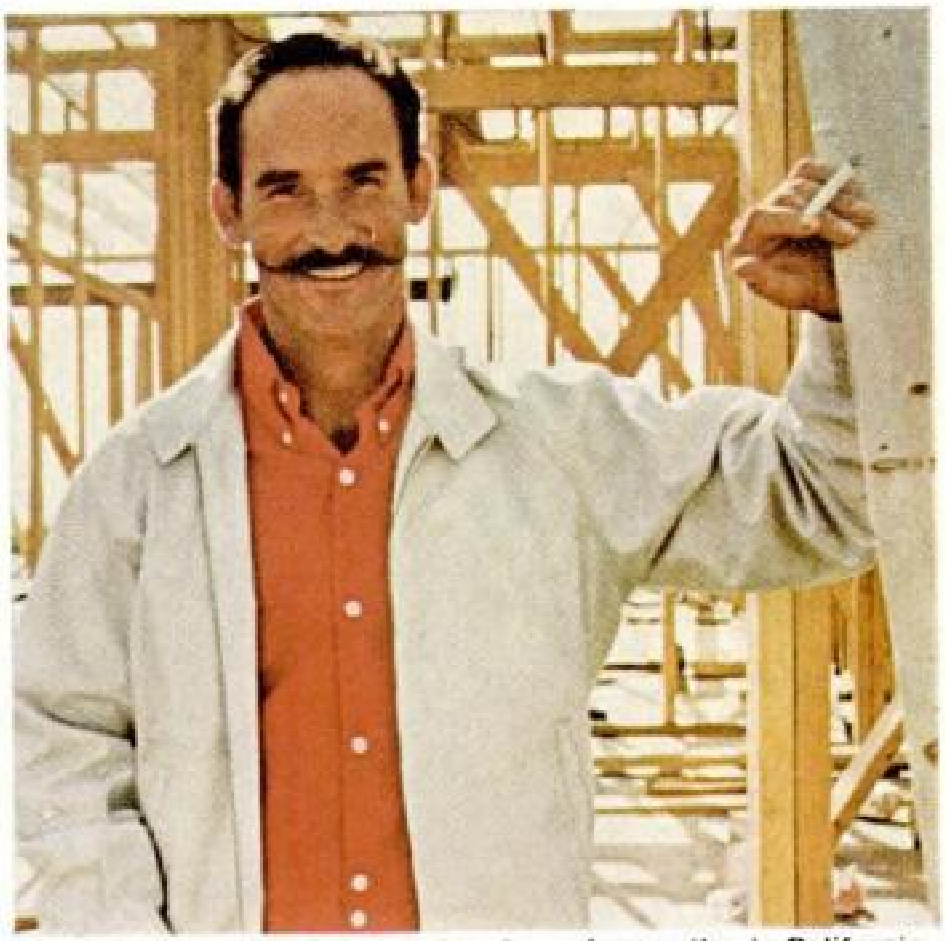

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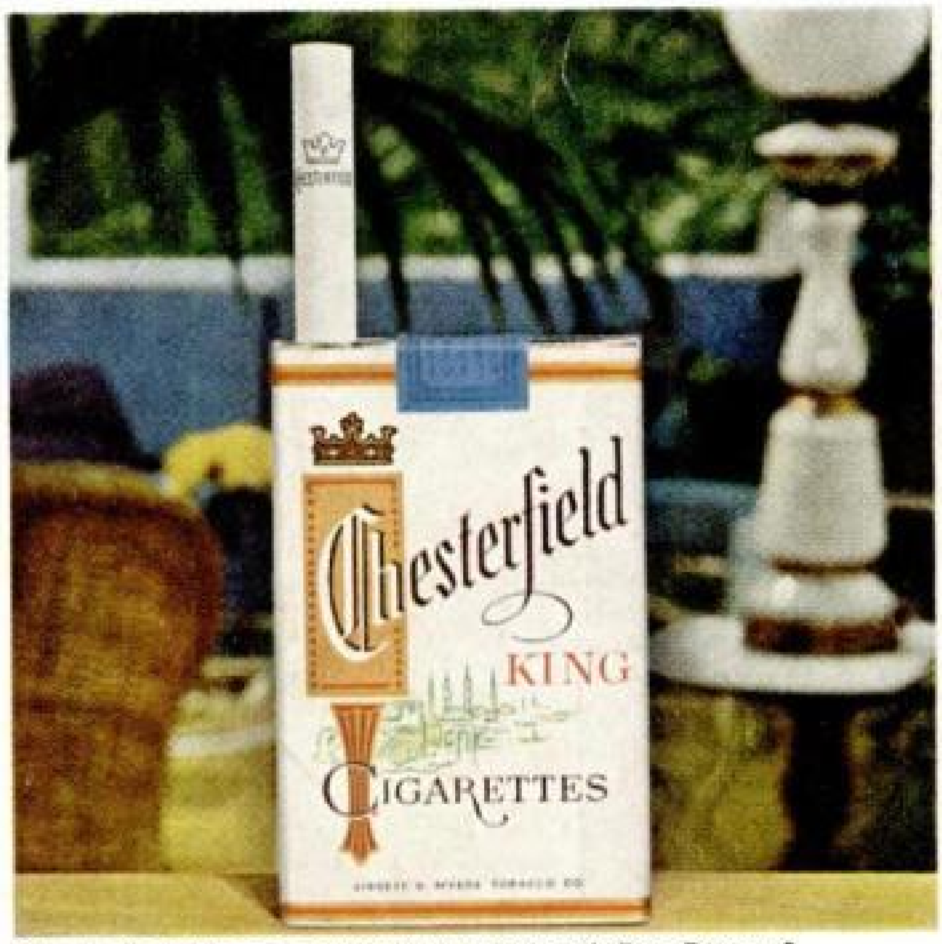

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